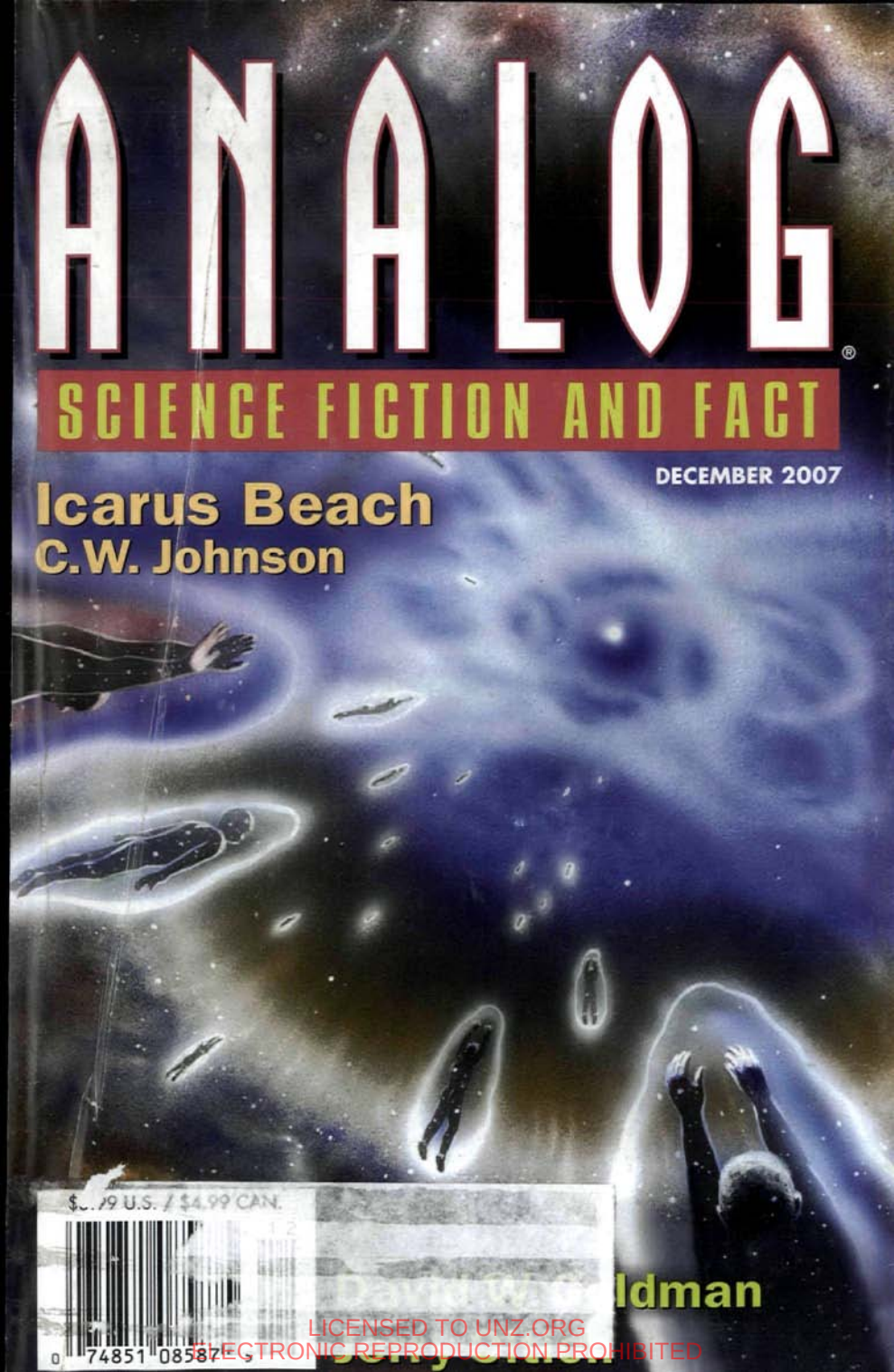

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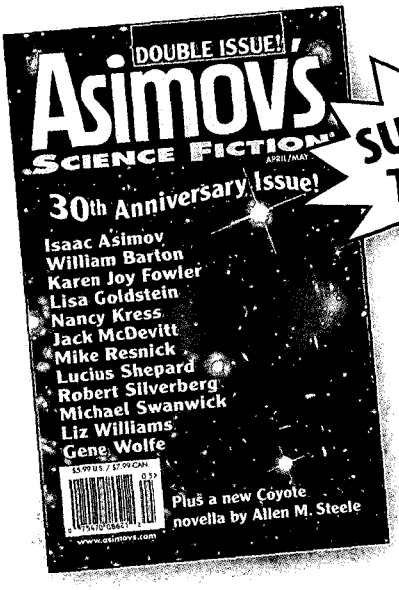

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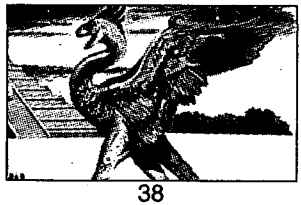

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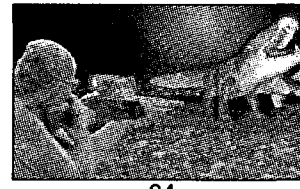

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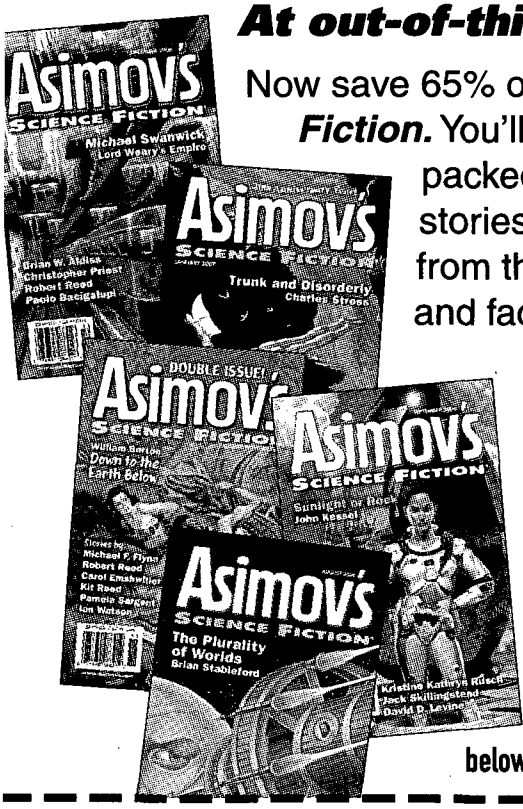

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EDITORIAL Stanley Schmidt

... HELP THE MEDICINE GO DOWN

Every few years, at least since the first Earth Day in 1970, it becomes fashionable for people to Care About the Environment and Make Sacrifices to Save It. For a while lots of people try to drive less, raise or lower their thermostats (depending on the season), use local products, and recycle. Then the feeling of novelty wears off, they lose interest in self-righteousness, and move on to the next fad. None of which is surprising, given the popularity of living from fad to fad, but it does little good if there's really a long-term problem with pollution, resource depletion, or global warming. If these things are actually threats, ameliorative measures that work will require a long-term commitment from many people.

How might such a thing be made to happen?

I submit that most attempts have been doomed from the start because they fail to allow for the realities of human nature. Not just fickleness and shortsightedness, but really basic things like this: unless people personally see and feel a compelling reason to do otherwise, they will almost invariably choose easy and comfortable ways over difficult and unpleasant ones. Maybe that's a character flaw, but it's a reality, and any serious attempt to change behavior in a lasting way will have to take it into account, not just wish it were otherwise.

Let's consider a couple of examples: using public transportation instead of driving, and disposing of toxic wastes responsibly.

We're often exhorted to take bicycles, buses, or trains instead of driving, because when a large percentage of people do so, traffic congestion, fuel consumption, and the generation of greenhouse gases are all reduced. Most people understand this, in principle, but many still choose to drive when the option exists.

Let us grant first of all that the option doesn't always exist. Some people must drive to work because they live in and have to travel between places where public transportation is not available and distance, terrain, or the loads they must carry make bicycling impractical. Others never drive because they live in places (like New York City) where public transportation is readily available and they can't afford to own a car or find driving one under local conditions too unpleasant.

Those who can choose are people between those extremes, and that's a pretty broad range. Personally, I always use public transportation to get into and around Manhattan, because it's usually pretty decent and driving there is a pain. (Okay, I confess: I drove into Manhattan once because my wife and I had tickets for a ballet at Lincoln Center and she broke her foot a couple of days before the show. But that was the only time in the last 30 years or so.) There are people who live in Manhattan and routinely drive there because, for them, the annoyances of driving are less onerous than those of using subways or buses. (Of course, some of them don't really

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drive there, but hire chauffeurs to do it for them—which is a whole other kettle of worms.)

For some (but by no means all) of the places I go near home, in a rural area utterly different from Manhattan, I *could* take a bus, if I absolutely had to. But I would waste a great deal of time doing so because there are very few routes and they run so seldom that I would spend hours waiting for buses. If I drive, I can go directly to where I need to go, do what I need to do, and go directly home (or to my next errand). There are often so many things that I have to do, in scattered locations, that that advantage is important. Even if it were not a matter of strict necessity, I freely confess that, like many people in a similar situation, I would seldom pick the bus. Life is too short to spend any more of it than I have to waiting for buses.

And there's the rub. Using mass transit For the Good of All sounds very noble in the abstract; but if someone has become accustomed to the convenience and privacy of having his or her own vehicle to go exactly where they want to, door to door, on their own schedule, with no extra stops, it will be really hard to see standing on a hot, crowded, noisy, dirty subway platform, wondering when the train will come and hoping it will have a vacant seat, as an improvement. Those who would have everyone take mass transportation whenever possible will have to come to terms with that fact. Many people will choose the subway or bus if and only if it truly seems the better choice, not only in abstract philosophical terms, but at the gritty level of everyday personal reality. For me, it meets that test in Manhattan, because the trains run frequently and miles and miles of slow, incessantly horn-blowing traffic make driving too tedious. But I can understand part of the reason why that traffic is so tedious: some of those drivers are there because they find the aforementioned conditions in the subways as unpleasant as I find driving above them. It's a matter of personal preference, and ultimately that's what most people will use to decide.

The lesson is simple: if you want more people to use buses and subways, you have to make them more inviting. They have to take people where they want to go, when they want to go, with an acceptable level of comfort and perceived safety. New York subways do pretty well on convenience, but others, such as Montreal, show that they could do far better on comfort and esthetics. Yes, making subways more appealing would cost money, and most people claim to be (and are) already overtaxed. But if Concerned Citizens really want it to happen, they will have to find affordable, cost-effective ways to do it.

How about toxic waste disposal? Few of us would say that we want our fellow citizens dumping last year's snowblower fuel and pesticides into our drinking wa-

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ter sources, but what else can they do with it? To their credit, many municipalities and counties now hold periodic household waste disposal days on which residents can bring such things to be disposed of by workers trained in their safe handling. Less to their credit, these programs are often set up in such a way that they are at best inconvenient and difficult, and at worst impossible, to use.

I recently took several years' accumulation of chemicals to one of these. It was several years' worth because we had not been able to get a slot on several previous attempts. Even though the county says it's doing this to encourage all residents to do the right thing with their hazardous household chemicals, they only hold the day for doing so once a year, and limit it to the first 400 people who call to make an appointment.

The population of the county is roughly 100,000. What are the rest of those people doing with their toxic wastes?

No doubt some, like us, collect them for several years and bring them all in at once when they get the chance. But others, no doubt, lose patience with that and simply find their own ways to get rid of them, some of which we'd probably rather not know about.

Furthermore, when we got to the collection site—twenty-plus miles away, at the other end of the county—we had to wait in a line of idling cars, in the rain, for more than half an hour. We'll do it again, if we must; but I wonder how many in that line will decide it wasn't worth the trouble, and resolve not to repeat the experience.

I'm not sure how it can be improved. Here's one thought: This same county has several town recycling centers open on a regular schedule year-round, and closer to most residents' homes. Could their services be expanded to include collecting hazardous wastes? Yes, I know people doing the ultimate disposal need special training, and I realize that any extra service will cost—and that residents of this county are (again) already overburdened with taxes. But sometimes clever people can find ways to do things less expensively than they thought. E.g., might the local recycling centers just store the stuff, and then periodically take it to a central location for final disposition by specialists?

My purpose today is not to provide the answer (though I would if I could) so much as to get at least a few people

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thinking about it, in the hope that some of them will come up with answers. We need them; these questions are important.

And answers that ignore the way people actually make personal decisions are hardly answers at all. People will swallow bitter medicine if they absolutely have to, but by the time they're convinced of that, it may be too late. If you want them to take it sooner, you must make it as palatable as possible. ■

IN TIMES TO COME

Our next (January/February) issue is one of our two annual doubles, and leads off with an oversized opening installment of Joe Haldeman's new serial, *Marsbound.* The title lends itself to at least two interpretations, both of which are at least partly applicable. And while the story does involve Martians, they are, as Joe puts it, "not your grandfather's Martians." You'll see that as soon as you meet them, and likely find them among the most intriguing aliens you've ever encountered. But there's much more to them than meets the eye. . . .

Back in 1998, Tom Ligon had a fact article here called "The World's Simplest Fusion Reactor," which attracted plenty of attention both among our regular readers and "outside." Next month he's back with "The World's Simplest Fusion Reactor Revisited," an in-depth follow-up about bigger and better research along similar lines done by folks including, among others, Robert Bussard.

And, since it's a double issue, we'll have lots more fiction of all shapes and sizes, by such writers as Barry B. Longyear (yes, Jaggers and Shad are back!), Geoffrey A. Landis, Ron Goulart, Wil McCarthy, Jerry Oltion, and Carl Frederick.

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Icarus Beach

C. W. Johnson

How far can our culture's obsession with "extremes" go?

As Kazo plummeted toward the heart of the doomed star, she thought of what Apilak had told her:

Love, Apilak had said, *is no more eternal than the stars. It may burn slow and steady for a long time and then gradually shrink away, or it may burn bright and hot for a brief period, only to end spectacularly.*

Like a supernova? Kazo had said, her voice sharp with sarcasm.

Apilak laughed. *Of course!* And then Apilak added softly, *But those are cynical words. We live in the light of ephemeral suns, Kazo. We all need that light.*

Now, falling, Kazo felt only darkness.

In the dark of her cabin, when Majnu had touched her, Kazo had felt the searing heat of desire; the dark swirled around their bodies, but inside, beneath her skin, in her lungs and her thighs and her head, heat and light roared and filled her.

They met shortly before the supernova, in preparation for the rare tarindhu celebration of rebirth. Once or twice a century, when a massive star ripens to death, a few hundred thousand of the galaxy's most devoted, superrich tarindhus gather to witness the explosion that destroys the star while simultaneously reseeding the starlanes with heavy elements. Of those devotees, maybe a thousand will descend into the heart of the star and ride the shockwave. A third perish, the most honored of deaths. And to survive—survival heralds the rise of a family's fortunes, both material and spiritual.

Although she had never been through a supernova, Nagaan Kazo had had many adventures in her young life. The Nagaan family—Kazo, her older sister Kumko, and their mother Haisho—worked as guides aboard the starcraft *Umialik*, hired by the superrich to tour extreme environments of the galaxy.

Apilak, the owner and captain of the

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Umialik, was a genius at spinning knotted anomalies into brane-shifted blisters, best in all the galaxy. She never lacked customers.

When word spread that the star Maishaitan was nearly ripe, Apilak put the services of her ship out to bid. She won a contract with old Samraatju Rajraan, to carry him and his third brood of children to the supernova. The Samraatju owned a flock of moons that manufactured knotted anomalies. Apilak's price: sufficient knotted anomalies to fling the *Umialik* across the galaxy and back a hundred times.

Nagaan Haisho, Kazo's mother, did not reveal her price.

They were to collect the Samraatju brood on Kitna Two, at a seaside town at low latitude. The air was thick and hot, the sky tinged toward the color of a yellow fruit above a steely sea. Kazo begged to go swimming.

Haisho looked at her for a while, silent. Kazo thought of her mother as a bar of old iron, unbending, the surface scuffed but unreadable. At last Haisho nodded. "Come immediately when I signal." And off Haisho went, followed by her other daughter. Walking away Kumko looked back over her shoulder, glanced right and left and made a sour face at Kazo. Kazo stuck her tongue out at Kumko, then ran down the lane to the beach. She kicked off her sandals as she crossed the hot sand. At the water's edge, where sea foam shivered in a slight wind, she pulled off her tunic and pants and splashed naked into the waves. Salt water filled her mouth. She spit it out and dove down deep.

Kazo loved swimming in the cool silent world beneath the surface. It was calm and peaceful, like the space between stars, but more comforting. Kumko was afraid of the water, afraid of drowning, although she regularly did far more dangerous things in space. Haisho had no use for the sea, for it could give neither advantage to the family nor enlightenment and release from the burdens of this plane. Kazo disagreed: swimming beneath the waves was the closest she felt to detachment, but Haisho said it was an illusion and dangerous for its feigned peace. "You cannot stay there forever. You must always come up for air. What kind of peace is that?"

"I'll graft gills," Kazo shot back, but she did not have them yet, so she swam up to the silver mirror of the surface. Salt water streamed down her face as she gasped air.

When she waded back ashore, squeezing water from her hair, she noticed a boy sitting beneath a lone tree on the beach. He was lean and dark, darker than Kazo even, wearing only short pants and sandals. In the meager shade of the tree he cradled a bookslate and did not seem to notice her.

Kazo bundled her tunic and pants under her arm and walked toward the boy. He was only a little younger than her, and beautiful, with long black hair that flowed over his narrow shoulders and down his chest. Around his neck he had a pendant, the wheel of stars of a tarindhu. She stopped before him, as the hot sun dried the last drops of water from her skin, but still he kept his head bowed. "Samraatju?" she asked.

Now he looked up, shielding his eyes with one hand, and nodded. "Samraatju Majnu." He glanced at her bracelet, with the wheel of swords of the taruddhist. "You?"

"Nagaan Kazo. We're to guide you at the supernova."

"Have you been through a supernova?"

Kazo laughed in surprise. "The last supernova was seventy years ago. My mother went through it, in her youth. She'll teach you."

But now Majnu was looking down the beach, where three figures distorted by the heat walked toward them. "My brother and sisters," he murmured. "Best get dressed or Gojraan will make a

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nasty remark. He probably will anyway."

As Kazo slipped on her clothes, the figures trudged across the sand, morphing from wavering black sticks into solid human forms. The man in a linen tunic and shorts was heavyset, with a pale, milky face, a black mustache, and a black scowl. Majnu's sisters were dark and slender like him, one tall and one petite. The shorter girl broke away from the others and slid into the sand next to Majnu. "Hi," she said cheerfully. She looked about Kazo's age. "I'm Kushri."

The other two looked much older than Majnu. The tall sister studiously avoided looking at Kazo, while the brother, who also wore a tarindhu wheel-of-stars pendant, stared coldly at Kazo. Kazo turned and looked out at the water, wishing she were in the peace beneath the waves.

Kushri picked up Majnu's bookslate. "What're you reading?"

"Probably about supernovas and singleton blisters," said the brother. "*Reading* about them won't help you, not this time."

Majnu's face darkened. "We'll have edit lessons. . . ."

"Idiot. You'll need more than cortex memories, conscious memories. You'll need kinesthetic memories, too, *body* memories."

"You haven't been in a blister either, Gojraan," shot back Majnu.

"We'll see who survives." Gojraan kicked at the sand with his foot. "It's hot out here. I'm thirsty." He looked directly at Kazo. "Get us some juices."

"Oh, don't be rude," Majnu said, frowning. To Kazo he said, "Sorry."

"I can say what I like," Gojraan said. "You can't stop me."

Kushri rolled her eyes and said to Kazo, "Forgive my brother, he doesn't pretend to have manners when Father is not around. He doesn't care about the supernova, except that Father wants us to go." She leaned forward. "He doesn't know whether this pilgrimage means Father values us highly or not at all. What do you think, Sundshri?" The other sister said nothing, her face hard and cold as a block of ice. Kushri laughed. "Well, I don't care. I'm looking forward to it, and I think Majnu is, too."

"Are you?" Kazo asked Majnu.

He nodded, his face very serious. "Yes, of course. When do we start practicing?"

Kazo brushed sand from one foot, wiggled her sandal back, then looked up at the sun in the sky. "Tomorrow."

"The cosmos inhabited by humans and stars," began Haisho's lecture aboard the *Umialik,* "is but a thin slice of all that is, a brane tucked between tiers of a universe richer than we can see. Humans move, breathe, love, and die in three spatial dimensions (and drift inexorably along the current of Time), but there are more dimensions, uncountable dimensions. Most are knotted tighter than the waistband of an electron, but a handful extend the width of a hair, and three, *attask, marruk,* and *pingayuk,* stretch out to infinity. Back in the start of history it took humans hundreds of years to get this story right. . . ."

Gojraan sighed impatiently.

"There are an uncountable number of forces, but only four are strong enough over any distance to make a difference in human life. Of those four, three transmit exclusively across the taut surface of the brane. The last, Old Man Gravity, is not really a force at all, at least not like the others, and he can reach beyond the surface of the brane; this is gravity's power but also, fortunately, the cause of his weakness. . . ."

Another sigh, louder.

"Be quiet," Kushri murmured from behind her brother.

"But I know all this already," Gojraan said in a loud voice. "It's the same principles as star-drive. Is boring us supposed to help?"

Haisho stopped. Silence draped across the room, then tightened. Gojraan crossed his arms in front of her

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chest. Finally Sundshri said, "Why not let Nagaan finish? After all, Father paid her an enormous sum to teach us. He would be disappointed if we were . . . impolite to her." She turned and gave a shallow bow to Haisho, who bowed deeply in return. After a long silence Haisho continued.

"The decay of a knotted anomaly displaces a pocket or blister of the brane off into one of the extranormal dimensions. To drive between the stars one must cast off into the deep void of *attask* or one of the other Great Dimensions, where one slides from star to star like a child down a snowy hill. . . ." For the task of tourism in the more dangerous corners of the cosmos, Haisho explained, and in particular this pilgrimage, however, the brane blister is shifted ever so slightly into one of the Lesser Dimensions, less than the thickness of an insect's wing. Shifted just far enough that inside the calm of the blister the densest matter and the fiercest fires of the normal universe, even the implosion of a supernova, are but ghostly shadows.

Although a brane blister can pass through the dense material of a ship, Haisho told the Samraatju siblings, and even through the impossibly hot and dense matter at the core of a star as if it were not there, in compensation the weak nuclear force is stronger and in fact one interacts mostly with neutrinos on the normal brane.

"You will sail on neutrino winds. With practice you can gain considerable control. The brane-shifted blisters Captain Apilak spins out are spheroidal, with an oblate deformation. They are not rigid, but sensitive to the electrostatic field of your body. You control the blister through your body: by stretching out you increase the oblateness and thus the area of the blister, catching the local neutrino flux. . . ."

Haisho explained how one must not move too violently within the blister. A brane blister can resist any force from the normal brane. But from the interior the blister is surprisingly fragile. Quick or abrupt motion can start an instability that will grow, ripples which will tear apart the blister, "and you do not want that to happen deep inside a supernova," Haisho said, a grim iron smile fixed upon her face. "This is a supreme test of your concentration and control. At the supernova you will be awake for almost five weeks and in constant control, and at the moment of implosion you must remain calm, dispassionate, or else you will die with the star."

She also warned them that although brane-shifted blisters pass easily through ordinary matter, they are not invulnerable to each other. They can even collide and set off instabilities. "So watch the beacons attached to each of you—it serves as both communication and tracking. Do *not* turn off your beacon."

When the lectures were over Haisho led them through the first exercises, based very much upon *ta-ichi* meditative dance, moving limbs slowly in the microgravity of the drifting ship. To Kazo's surprise, Gojraan picked it up quickly.

The younger sister, Kushri, was flailing much too fast. Kazo drifted over to her, caught her wrists, and moved her arms through the exercise. Kushri said nothing, closed her eyes, and then moved her arms and legs slower. Then she turned to her brother Majnu, who had been watching her with his dark, intense eyes.

"Show me," Kazo said.

Majnu nodded and began the cycle of movements. "I'm not very graceful," he murmured. "Gojraan spends all his time in the fighting arts, that's why he picks it up quickly."

Kazo watched him. "Not bad," Kazo said, "but it's flat, which means you might let down your guard. You must clear your mind, be calm—I don't care about the state of your soul, but if you don't, disaster follows. I say this, and I don't even like to meditate."

Majnu nodded and moved again.

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"How's that?"

"Better, but don't do it for praise. It must feel like your hand is following a grooved path, a geodesic. It must feel like the most natural thing in the world."

Pearls of perspiration appeared on Majnu's forehead, despite the slight chill in the air. "How does anyone survive?" he asked.

"Most tourists, pilgrims in this case, have an electrostatic generator strapped to their waist that expands and contracts the blister."

"Why can't we?"

"Because then you would be just a piece of meat trapped inside a blister. You are a human being, in control of your destiny. Anyway, it's the oblateness. Apilak is one of the few skilled enough to produce *oblate* blisters. Most are spherical and can only expand larger or smaller, with very little control: you can only rise or fall. With Apilak's you can pitch and yaw and actually *soar* and *sail*. It's fun." Kazo smiled and Majnu smiled back.

"Is he doing any better?" Kushri asked.

"No," blurted Majnu. "I'll have to practice."

"Good, because tomorrow you learn to damp out instabilities. That's harder." When Majnu's eyes widened, showing white against his dark skin, she added, "And necessary for your survival."

They practiced for three days as the *Umialik* slid inward toward the yellow white star Kitna. The night before their first trial run, Kazo returned to her private cabin. For the moment she was glad to be away from people, away from everyone. Gojraan had been particularly insufferable, insisting he need not practice anymore. "Your father will be displeased with us if you should die on a practice flight," Haisho had said quietly.

"Yes, yes, that'll be too bad for you, won't it?" said Gojraan. "He'll probably find a way to banish you to the most impoverished, crowded, stinking planet there is. You should pray your little *kak* prayers that I don't die." His sisters just looked away.

The cabin door closed behind Kazo. The room was silent and dark, and though she felt a strange twist of loneliness in her gut, she kept it unlit. Her mother would have preferred the three of them to share a single cabin. Haisho seemed to think lack of privacy built moral character and family solidarity, and she told stories of her own childhood, growing up in a tiny apartment with her uncle's crowded family on Saruna—exactly the kind of world Gojraan had threatened them with. Haisho openly despaired of the fragmentation of the family, but on this trip the *Umialik* was nearly empty, and Kazo and Kumko simply moved into empty cabins.

Still, as Kazo lay down on her bunk, simultaneously exhausted and too upset to sleep, she would have liked to talk with her sister, or even her mother. Or maybe Apilak. The ship's captain was busy preparing for the first flight, but disembodied, she never tired, was always patient and thoughtful.

Kazo had sat up, readying herself to call Apilak, when her door quietly chimed. She frowned. It wasn't Haisho or Kumko's chime. It had to be one of the Samraatju. She tensed. Gojraan, wanting to rape her?

"Yes?"

The voice was soft and shy. "Kazo? It's Majnu."

Kazo hesitated for a moment. Majnu was still a Samraatju. He might still have come to rape her. Sometimes you had to be most careful with the quiet ones.

But Apilak had surveillance programs, and Kazo didn't think Majnu sufficiently skilled to overwhelm them. So she let the cabin door slide open. "Yes?"

Majnu stood in the doorway, a slice of shadow. He looked down and away from her, his loose hair falling on either side of his face like a curtain of night. He

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stood there without speaking, so long that Kazo was about to order the door shut. At that moment he murmured, "I'm not ready."

"Pardon?"

Majnu lifted his head and glanced up and down the corridor, glanced up above. "I'm not ready for tomorrow. I need more practice."

Kazo started to roll her eyes at this transparent excuse when Majnu shifted and light fell on his face, illuminating his sorrow and worry. "Oh, all right," she sighed. "Shall we go to the exercise room?"

"I don't want my brothers to find out. They have spy programs—"

Kazo snorted. "I doubt that. Apilak has probably already crippled them. She doesn't like spies running through her ship."

"I wouldn't be too sure. Gojraan is more clever than he acts."

Kazo went on: "And you should know, her own surveillance subprogram keeps a close eye on me. In case you have any ideas."

She went to the back of her cabin, felt around for her exercise tunic, and in the dark quickly dressed. Majnu stayed at the doorway, outlined by the corridor light. "I don't have any ideas, I promise."

"Promise all you want, but I have dealt with the superrich for years. You think you hire us, you hire our bodies for whatever you want."

"What, has Gojraan propositioned you? You should know, the last time he propositioned a hire-servant, er, Father threatened to castrate him and not regenerate his testicles for ten years." Kazo laughed at the image. Majnu continued: "So don't let him bully you."

She walked into the corridor, blinked in the light. "I don't let anyone bully me." They walked in silence for a while. The ship was quiet: everyone, except Apilak, asleep. Kazo said, "You don't have to be afraid. At least not tomorrow. It's not very dangerous, if you don't panic."

"I'm not afraid."

"But you come to me in the middle of the night to practice."

"Not afraid of dying, I mean."

"What are you afraid of, then? Of looking bad to your father?"

Majnu thought on this for a while. "I think, if we are at least acceptable, he does not think much upon us. Only if one of us, usually Gojraan, acts badly, which reflects badly upon *him,* does he care. I don't think I could do anything *well* enough for him to be impressed."

"Then what?"

They arrived at the exercise room. "I don't know." He turned and looked at her. His eyes were the color of darkest tea, just a thin rim of white around the irises. "Do you always know the reasons in your heart?"

She smiled and went through the exercises with him. He did much better without his family. After two hours Kazo was impressed with Majnu's determination. Perspiration pooled on his brow from the effort.

"Stay relaxed tomorrow," she said. "You'll be in a closed blister, you don't want to overheat."

He smiled shyly. "Hard to imagine not overheating, skimming just beneath the surface of a sun."

Kazo felt a drop of sweat on her own face. She grabbed a loose towel and wiped her face and then, upon a sudden impulse, reached over and gently dabbed at Majnu's face. The tip of her fingers grazed his moist skin, and her heart suddenly boomed in her chest. She was taken aback at her own boldness, touching without permission, without need, the son of such a powerful house. But he just closed his eyes, his lips curled slightly upward. "You'll do fine," she said quietly, softly, against the loud bang of her own pulse in her ears. "I'll be with you tomorrow."

"Will you?" he asked, looking her direct in the face.

"Yes," she said. "I promise."

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A few hours later, they were falling toward the star.

In the ghostly realm of brane blisters the star was a pale glowing flux of neutrinos, while each brane blister appeared as a faint shadow and the bright neutrino beacon that doubled as a comm link. Kazo kept a close eye on Majnu's blister, and when she saw a ripple of an instability she coached him through stabilization.

Good, she said to him over the link.

It was a short maiden flight for the inexperienced group. The hardest part came at the end, as retrieval of brane blisters is much harder than deployment. Ironically it was not Majnu who had difficulty—he correctly destabilized the blister on cue and appeared in an eye blink inside the *Umialik*'s equipment hold—but Kushri. After nearly an hour of trying, she finally tumbled into the normal brane, wan and exhausted. The *Umialik* began to accelerate away from the star, and every one in the central hold gently fell to the wall under the light gravity.

As they trooped out of the equipment hold, Majnu turned and faced Kazo. "Thank you," he said softly.

"You did well."

He shook his head so that his black hair waved from side to side, and he bowed to her. Then he stood and looked her full in the face with his deep brown eyes. Kazo blushed, even as he turned away and walked quickly after his sister.

Kazo went back to her cabin. Her stomach tumbled round and round: the aftereffect of the brane blister, but more. She kept seeing Majnu's face, the slight curl of a smile on his lips, his eyes like coals aflame.

For three more weeks they practiced at Kitna, dipping deeper and deeper. Kazo marveled at the expense of so many knotted anomalies.

The practice was needed, especially by Majnu. On longer excursions he got tired and had difficulty focusing. Kazo marveled that Gojraan, who on the normal brane seemed so easily bored, had little difficulty; a shame, as Kazo secretly hoped he would have an accident, never mind the consequences.

In the third week they went all the way through the star and out the other side. Kazo kept a close watch on Majnu, staying less than half a kilometer away from him as they descended deeper and deeper into the star, the neutrino flux grower brighter and brighter. Gojraan looped around them, crying out, *Look, Majnu and his nanny! Majnu and his nanny! Did she bring milk for you to suckle?*

Kumko glided close to Kazo and said quietly, *Let me watch him for a while.*

No, I can, really. The brother doesn't bother me. . . .

"The brother" bothers Majnu, though. Let me watch him.

Reluctantly Kazo broke away. Far away, against the dawn-bright shine of neutrinos, she saw Gojraan's beacon. With a sigh she tucked her limbs in and plunged toward them. Gojraan was looping up and down rapidly, making himself as small as possible and hurtling downward, then spreading wide his arms and legs and abruptly sailing up.

When Kazo got close, he looped up and corkscrewed around and past her. Be a show-off, she thought to herself. Be a show-off and kill yourself.

Gojraan wheeled around and rocketed past Kazo again, his beacon flickering rapidly, transmitting a whooping stream of high-spirited yells. She pulled her limbs in tight and dropped out of the way just in time. A collision between brane blisters at high relative velocity can set up instabilities dangerously difficult to damp out.

They didn't have any more trouble until they had passed through the core and were on their way out.

Around the twentieth hour of the excursion Majnu began to slip farther and farther behind. Despite the drugs they all received to keep alert, exhaustion

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made it difficult for him to keep aligned. *I'll coach him,* Kumko murmured to Kazo, and she dove down and gently spiraled around Majnu, coaxing and encouraging him.

The rest of us will ascend on schedule, said Haisho. Kazo bit her lip and floated upward, but she kept glancing down. Majnu and Kumko fell farther and farther behind: ten kilometers, twenty, fifty, a hundred, two hundred, until she could barely make out the bright specks of their beacons. Kumko had turned down her beacon so that no one could listen in to her coaching, but Majnu's transmissions were clear for all to receive.

I can't, I can't, cried Majnu. Presumably Kumko said something in return, but Majnu called out, *I'm falling, I'm falling. Kazo! Please help me, Kazo!*

Kazo's head jerked around and she looked down into the dull haze of the neutrino flux, saw the flickering dot of light that was Majnu's beacon, calling her name, pricking her heart. Her body tensed, but her mother's voice cut in sharply: *Leave it to Kumko. She can deal with him. We have the others to watch.*

Kazo considered defying her, but Haisho was right. Kumko was a better coach, and too many people would only make Majnu more nervous.

Kumko and Majnu rendezvoused with the *Umialik* five hours later than the others, and when Majnu popped back onto the normal brane he was pale and shaking. As they all walked out of the hold, Gojraan said mockingly, "Kazo! Kazo! I'm dying! Help me, Kazo!" He looked up at her, a smirk on his face.

Kazo marched over to Gojraan and slapped him.

Gojraan looked stunned. His siblings stared at Kazo. Everyone was frozen, except for Haisho, who grabbed Kazo's arm and hauled her to one side, away from the other. Haisho's iron-block face loomed in Kazo's vision, like an eclipsing moon.

"You must apologize immediately!" Haisho said in a low, stern voice.

Kazo squirmed in her mother's grip. "He deserved it."

"Kazo, I say this for your own good. Apologize immediately. Let him receive discipline from his father—not you."

"So what? So what if old Samraatju fires us? Who else will guide them?"

Haisho's black eyes fixed on Kazo. Her voice was cold. "Listen to me. I know Samraatju Rajraan. He will discipline his son for misbehavior. But he will also visit his wrath upon someone who assaults the flesh of his flesh. He is super-rich . . . and he can make terrible things happen. Terrible things to *your* flesh. I would be unable to protect you. The contract, Kazo, I have told you to read the contract. Do not touch the flesh of his flesh, in *any way*. Now apologize. Before it goes further."

Haisho loosened her grip on Kazo's arm and Kazo shook free. She turned back and looked at the Samraatju siblings, who were all still staring at her, even Majnu.

With a sick lump in her stomach, Kazo walked over to Gojraan, knelt on the floor, and bowed, saying, "I was wrong to strike you. Please accept my apology."

With her forehead resting on the floor, she felt movement nearby, and for a moment thought that Gojraan was going to kick her. But Sundshri's sharp voice cut through: "Gojraan!" And then: "He accepts your apology."

Gojraan bleated, "But she—"

"Gojraan."

He fell silent. Kazo stayed bowed, felt a breeze as Gojraan and the others walked away.

Kazo did not leave her cabin for an entire day. Her body and mind were so knotted she could not sleep. The air seemed hot and thick as stew; she lay naked on her bunk in a dreamless daze. She did not answer the comm link, did not respond to knocks on the door.

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"Apilak!" she shouted. "I know you're listening! Tell them I'm . . . I'm not coming out."

Then she did sleep, and when she awoke she sat suddenly upright on her bunk, the salt of her perspiration crusted on her skin, but her body and mind felt cool and alive. She heard a soft tap-tap at her door and she opened it, cursing herself even as she did so (she was naked), and feeling a thrill of terror, for it could be anyone, even Gojraan—and for an instant she thought standing against the bright corridor light was the broad outline of the elder brother. But then the silhouette in her vision shrank.

"Majnu," she whispered. She took a step back into her dark, cramped cabin, grabbed at a blanket on her bunk. He waited at the threshold to her cabin, saying nothing, not even looking at her nakedness. She gripped the blanket. "Majnu?"

At last his pink tongue licked around his mouth and he said, in a soft croak, "There are so many things I would say, but I can't find the words."

Slowly she put the blanket down on the bunk, went and drew him inside, closing the cabin door behind him. She put her hand on the soft skin beneath Majnu's chin and lifted his head so that his eyes met hers. She told him, "Apilak says the universe began as a word, and of course she so believes, because she is just words."

"Do you believe that?"

"I believe almost everything Apilak says, but I think words are not enough."

"Why?" he whispered.

"Because we can do so much more with our mouths than speak," she said, adding, "and here is the proof," and she put her mouth on his, and it tasted like sweet wine, and his breath felt like a hot wind that falls from a high desert, and the darkness swam around them like a warm sea, and they both drowned in each other's bodies, that night, and the next, and the next.

* * *

He was gentle, much gentler than any of his siblings, even his youngest sister Kushri, which continually surprised Kazo: she expected him to be spoiled and self-indulgent. In her experience even the "kindest" superrich clients were merely polite when they made demands. He was so gentle that when she barked at him during further practice excursions he nearly came to tears, and later, in the dark of her cabin, she kissed away those tears. "We agreed, you know," she said, and he nodded. They decided to act as if they were enemies, and her humiliating, forced apology to Gojraan gave her good reason to hold a grudge against Majnu. So they kept their affair secret. Even Kumko said at one point, "Go a little easy on him, Kaz, he's trying hard, he's getting better."

Of course Apilak had to know. She knew everything that went on in her ship, her body, saw everything and forgot nothing. But the captain of the *Umialik* said nothing to Kazo, not even in warning, which Kazo had half expected, and Kazo trusted Apilak to say nothing to anyone else.

In Kazo's cabin, late at night, they pressed their bodies together with a fire and a ferocity they could not explain; and after they would whisper their stories. Majnu asked her about her adventures, took her seriously in a way no one had before.

Majnu had had lovers before, of course, but in all of them he detected the marionette strings of his father. He admitted he at first suspected Kazo was another, which wounded her almost to tears, but he hastily said he knew that could not be the case, from Gojraan's beastly behavior toward her. "If Father had bought you," he said, "Gojraan would have sniffed it out and would either leer at you or ignore you altogether."

"I don't like this talk of your father *buying* lovers for you—and that you think I could be bought."

"I know you couldn't. But it would be

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easy for him to find someone who could be bought, one way or another. I don't think you really imagine the pressure he can bring to bear to get what he wants, both temptations and terrors."

"Does he really care?" Kazo asked. "About your lovers?"

"He doesn't cares about *me*. He only cares about his control over everything. With me, with all of us. He's picked out several possible consorts for Sundshri, and she hates them all but is too terrified to defy him, to even *think* about defying him."

"What would he do if he found out about me?" asked Kazo.

"I don't know . . . I don't *think* he'd have you killed, I'm not worth that much to him—"

The back of Kazo's skull suddenly felt ice cold. "That's not a comfort, when you put it that way," she said with a thick tongue.

"Sorry." He paused. "I guess he would see us separated."

Kazo's stomach sank. "So we have no hope?"

Majnu kissed her gently. "*I* have no hope. I don't own my life, my body, and I never will. My father considers it his. He will control my life, no matter what *I* want. And when he dies, some elder half brother I hardly know will control my life." He sighed and burrowed his head against Kazo's breast. "Sometimes I think it would be just as well if I died in the supernova."

Kazo stroked his hair. Her heart melted with sadness, listening to him. "I don't want you to die. I won't let you die."

Majnu whispered, "Sometimes you have to let go."

"That sounds like something Apilak would say."

"Do you love me enough to let go?"

Her stomach twisted. "Do you want me to let you go?" She silently wondered, was this just a ploy to get rid of her, when he was finished with *her* body?

"No, no, of course not."

"We could run away."

Majnu pulled away from her. "No, we couldn't. He would not care if I died, but he would care if I defied him. That would be unforgivable. He would pursue me, and you, to the edge of the galaxy. He has spies everywhere. We couldn't escape."

Hot tears slid from Kazo's eyes. "Then we have no hope, nothing."

"Hush," Majnu said, kissing her tears. "We have now. That is the only gift I can have. Now. This kiss. This night with you. And if I die at the supernova or if I live ten centuries, this night is greater than anything my father could ever give me." He kissed her lips. "I'm sorry I can't give you more. Do you want me to go away? If you feel I'm taking advantage of you—"

Kazo, tears still sliding down her face, reached up and put a hand on his mouth. "You hush," she said. "Hush now. Say nothing more. Remember, we are more than words." And she kissed him with a kiss meant to last a thousand years.

When the training at Kitna finished, the *Umialik* pulled into a tight orbit around the star, and Apilak let decay a handful of knotted anomalies. The decay burrowed a blister about the whole of the ship, dug not a few nanometers into a Lesser Dimension, like the individual blisters they used for excursions, but several millimeters into *attask*, one of the Great Dimensions. In the deep, gut-wrenching void of *attask* they slid from gravity well to gravity well, leaping from star to star across the galaxy to their next practice site: the snapping jaws of Fenris and the wheeling chain of Gleipnir.

"It's a strange name, Fenris," said Kushri. They were taking a meal on the normal brane, in orbit about a star halfway to their destination.

"It's from very old mythology," said

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Majnu. "Maybe from Home itself."

"It's a stupid name," said Gojraan. "Figure Majnu to know all about it." Majnu's face darkened, and he stared down at his plate of flat bread and salted tomatoes.

Kushri made a face at Gojraan and said to Majnu, "Go on."

"Fenris was a wolf, who threatened to devour the universe, or at least a planet or two. Gleipnir was the chain forged to bind him forever." He tore off a bite of flatbread. "Here, Fenris is the black hole, and Gleipnir the accretion disk. Right?" He looked at first at Kazo, but then his gaze skidded away and fixed on Haisho.

"Yes," said Haisho. "This will be considerably more challenging than Kitna. The neutrino flux from the accretion disk is very bright, brighter than a main sequence star. And erratic, *very* erratic. At the inner edge of Gleipnir, only a few kilometers from the event horizon, the tidal forces are very strong."

With a grin, Gojraan lifted up a piece of flat bread and tore it in two.

"Not quite like that," said Haisho. "But the tidal forces will be strong enough to affect your inner ear and cause disorientation."

Gojraan shook his head. "Not me. I always keep my wits tight. Unlike some." He grinned at Majnu, who went back to staring at his breakfast.

"Nonetheless," Haisho said sternly, "this will be *dangerous.*" She picked up a piece of cucumber and before popping it into her mouth, added, "Your father will be watching carefully from his ship."

"What?" said Gojraan.

Sundshri frowned. "No. Listen, Nagaan, Father is meeting us at Maishaitan, the supernova site. No."

"What?!" repeated Gojraan.

Haisho chewed thoughtfully, swallowed, took a sip of tea. "He apparently changed his mind. His ship is already in the system, awaiting us."

The Samraatju siblings looked at each other. "Will he be going down into Gleipnir with us?" Gojraan asked in his smallest voice.

Haisho shook her head. "As I understand, he will not. He will watch from his ship and will join us after your excursion. He is keen to find out how your training is going." She bowed her head close to the tabletop. "I hope my efforts will find favor with him."

There was a long silence, broken by the scraping of Kushri's plate on the table as she pushed it away, a sour look on her face. "I'm not hungry anymore," she announced.

Often, on the long freefalls between gravity wells, Kazo talked with Apilak. Kazo liked to think that Apilak felt more affinity with her than with her mother or sister, and imagined Apilak in some distant youth as passionate and impetuous as herself. Certainly, like Kazo, Apilak did not hesitate to speak her mind, although with more skill and cunning than Kazo could manage.

"I can't talk to my mother about Majnu," Kazo said. She had strapped herself to her bunk, to keep herself from drifting away in freefall. Her cabin she kept dark. "She would just talk to me about duty and all that. She wouldn't understand about love. Do you think she was ever in love? She's too careful and calculating to let herself get swept up in such powerful, so overwhelming feelings. . . ."

You should be careful about Majnu, said Apilak. *Especially after his father comes aboard. Old Samraatju will not appreciate you carrying on a love affair with his son under his nose.*

"Oh, no one knows but you, and besides, Majnu invited me."

If you had read the contract, as your mother instructed you to, you would find the clause . . .

"You're just as bad as Amma!" snapped Kazo. "You know nothing about love."

Neither do you, said Apilak. *You are too young. You know nothing of love,*

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or of pain, of loss and grief, all of which thread together.

"Well," said Kazo slowly, "have you every loved anyone? The way I love Majnu?"

Don't be impertinent, Kazo. I have traveled back and forth across the galaxy for almost a thousand years. I know your heart is overflowing, and it makes me smile to watch it. I know your love for the young Samraatju is real, but don't be insulting and think that you are the only one to love like that.

"Then tell me about your lovers."

My life is not a v-novel for your entertainment.

Kazo sniffed. "But you can watch mine. Oh, come on, Apilak. At least share with me some of your wisdom that you so mysteriously acquired on your journeys."

You need to control your sarcasm, Kazo; it has gotten you into trouble before, and will again if you don't.

"Please tell me?"

Apilak said, *Love is no more eternal than the stars. It may burn slow and steady for a long time and then gradually shrink away, or it may burn bright and hot for a brief period, only to end spectacularly.*

"Like a supernova?"

Of course! But those are cynical words. We live in the light of ephemeral suns, Kazo. We all need that light.

"Even you?"

Even me.

"Then who . . ."

Hush now. Not everyone may know the ending of every story.

The descent to Gleipnir was long. Because of the violent energies released as the accretion disk ground together matter, the *Umialik* had to stay tens of millions of kilometers away, avoiding both the accretion disk of Gleipnir and the polar outflows. Apilak piloted her ship in a tight parabola, accelerating straight toward the maw of Fenris. Then, in quick succession, the excursion group was enveloped in brane-shifted blisters. When the last was released, Apilak throttled the engines to skid the *Umialik* out of the plane of the accretion disk, up and out of the inner system.

Kazo was in blackness. The whalelike bulk of the *Umialik* had vanished. Inside the blister all she could see was the brightness of the ship's beacon and a faint smudge of flux from the engines. Ahead of her Gleipnir was a curlicue, violet and small, as if she could cup it in her hand.

Kazo sighed. Even at the high initial velocity Apilak gave them, it was a long fall in: more than twelve hours. They would have only six hours to skim along Gleipnir, then ascend for a grueling two days.

As they fell inward, Gleipnir grew larger and larger, a fiery snake writhing as it bit its own tail. When it filled half the sky, Haisho signaled to begin braking. In unison the group spread wide their limbs. Kazo felt the flux bite hard at her blister. Out of the corner of her eye she spotted Majnu wobbling a bit. She resisted the impulse to go to him, to call out to him. A moment later Kumko glided close to Majnu, with soothing coaxing. Gojraan's harsh laugh slashed out of the comm link: *Ha ha! Hey, Majnu, is Kumko your girlfriend? Better be careful, Father won't like it!* Everyone ignored his taunts. Gojraan responded by dropping faster.

Sir! said Haisho sharply. *You must reduce your velocity.*

There's plenty of time to brake, Gojraan called back, but his descent slowed.

Your father entrusted your safety to us, Haisho said, her words ringing clear and cold over the comm link. *We cannot allow you to get too far ahead.*

Gojraan said nothing, but quietly matched velocities with the rest of the group.

An hour later the outer fog of Gleipnir swallowed them. Here, in the accretion

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disk, gas torn from the red giant companion was spun into a broad carpet. Gravity compressed and heated the gas. First electrons were boiled off the atoms to make an x-ray soup. Deep down, by the inner edge of the accretion disk, the nuclei themselves of the atoms, banged incessantly against each other, began to scream in gammas and neutrinos.

Beyond that edge was the maw of the black hole Fenris.

As the excursion group entered Gleipnir they angled slightly eastward in the plane of the accretion disk, tacking off the neutrino flux to be captured into orbit. Soon they were skimming along the inner edge of the disk.

This is as deep as we go, called out Haisho. *Beyond is too dangerous.*

Kumko took the lead, tilting back her legs, so that the axis of the ellipsoid blister formed an angle with the neutrino wind. Kushri followed her, then Gojraan. Kazo reluctantly went next, then Sundshri, Majnu, and Haisho trailing behind, ever watchful.

The flux bucked and snapped at them. Kazo could see matter boiling, roiling, belching. Her blister shuddered and shook as the flux rose and fell. She glanced back at Majnu. She could not make out the phantom outline of his blister, but only saw the bright eye of his beacon drifting up and down. He was having difficulty with his balance, she knew, but she kept her mouth clamped shut. Haisho would be watching him.

They stayed in a tight group for a few hours. Kazo's blister trembled and vibrated as she skimmed forward over and through uneven patches of neutrino flux.

Then Gojraan got into trouble.

Getting more and more bored, Gojraan had been deliberately bobbing up and down in his trajectory. The occasional word from Haisho and he would snap back into line with mathematical precision. Then, predictably, he started ignoring the warnings. He soared up and above the others, then dove back down and pulled up at the last fraction of a second. He threaded his way up over and below streams of dense gas that glowed as nuclei within collided and broke apart. He picked up velocity and soon overtook Kumko.

Gojraan! Don't go ahead of me! Kumko called.

He gave no response. Haisho called out to him, but he ignored her too. Kazo saw his beacon, a tiny flickering spark, rise above the growing rim of Gleipnir. As he paused and began to dive back down, fast, faster, Kazo saw out of the corner of her eye her mother move past her, toward Gojraan. Gojraan's beacon went deep, deeper.

Too deep.

His ululating shouts of joy suddenly broke off—a moment's silence—then his voice, tight, almost a grunt: *Umm . . . it's, uh, sticky down here and I . . . I . . . I'm not rising back up.*

Immediately Kazo leaned forward and shot ahead, toward him. A hundred meters ahead of her, Haisho shouted, *Samraatju, all of you, go up, get out of here, go up fifty kilometers, you'll be safe there,* even as she too rocketed toward Gojraan.

But Gojraan was kilometers away, and Kumko was closest. Kumko's beacon streaked ahead and angled down.

My belly, I can feel my belly twisting, Gojraan called out, obviously panicked. Tidal forces.

Spread your arms and legs as wide as possible, called out Haisho.

I know that, you stupid dog, I'm doing that, I'm still sinking!

Haisho and Kazo quickly gained on Gojraan, but he was deep, hundreds of meters too deep now. They were only a couple of Schwarzschild radii from the event horizon, the gravity well tilted very rapidly here, as evidenced by the tidal forces tugging at their bodies, and even a hundred meters could make a difference.

Do something! cried out Gojraan.

Kazo chanced a glance behind her.

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She saw the other Samraatju siblings soar to a higher elevation. Not a word, not a sound came from them.

Kumko! called Haisho, and Kazo's attention snapped forward. In the glare of the neutrino flux she saw her sister's beacon arcing down toward Gojraan, going deeper and deeper . . . Something squeezed at Kazo's heart, something not a tidal force.

Kazo drew her arms and legs in tight and began sinking, and at the same time leaned forward, head down, willing herself toward Kumko. Kumko was closing on Gojraan now. Kazo and Haisho, traveling as fast as they could, were too far away.

Kazo saw Kumko's beacon down in the soupy glare, as Kumko went *deeper* than Gojraan. Then Kumko suddenly spread wide her blister, and she bounced off the thick neutrino flux.

Almost there, Kumko called up to Gojraan. *Be careful of the instability, you're going to have to damp it down instantly, all the while keeping your blister as full spread as possible. Almost there . . . I hope you are as good at this as you think you are. . . .*

A moment later Kumko's blister collided with Gojraan's. His blister was visibly knocked upward, Kumko's momentum transferred to him. Gojraan cried out with shock, and Kazo imagined him frantically trying to stabilize the ripples surging over the surface of his blister. But he must have succeeded: his beacon rose higher and higher.

In the meantime, Kumko, who had bounced downward, sank.

Kumko! shouted Kazo.

Sorry, Kaz, Amma, sorry, I've lost all my vee. Let's see . . . no, damn it, I don't have enough forward vee to vector up . . . damn—sorry, sorry. . . .

Kazo called out, *Hang on, I'll be there . . .* But then Haisho cut her off: *Kazo! I forbid you!*

But . . .

I will not lose two *daughters today!*

Kazo's stomach filled with ice at those words. Shocked into silence for a moment, she shook her head and shouted back: *Mother! I can't . . . we can't abandon her!*

They were over Kumko now, who was more than a kilometer below them and sinking fast. Her beacon was barely visible. Kazo spiraled around and around. Haisho said nothing. Gojraan, meanwhile, had struggled back to their elevation and was quietly rising.

Kumko! called out Kazo.

Don't! Don't try! Kumko called. Her voice was staticky, roughened by the thick neutrino flux about her. *Amma's right, you can't . . . sorry . . .*

And those were her last words.

Kazo lay in the dark, narrow confines of her cabin. Her whole body seemed to ache. She turned on her back and raised up a hand to grab at the dark. So close and yet her fist closed on nothing. Her tears puddled and cooled on her face.

Apilak called her, but Kazo turned over, wiping her face on the bedclothes, and told her to go away. What did Apilak know anyway? She was a machine, now at least, and maybe always (Kazo wasn't sure and wasn't rude enough to ask); she didn't have a body to ache at such loss. In Kazo's head her words were saturated with sarcasm and anger. Displaced anger, that's what Apilak would call it, Kazo thought, and sniffed through her tears. She tried to dredge up anger in an imagined conversation with Apilak, and then knew what Apilak would say to that: Kazo's real anger, at Gojraan, at Haisho, at Kumko herself, was too frightening to face.

Gradually, Kazo gradually became aware of a timid tapping at her cabin door. It had been going on for some time. *Tap-tap, tap-tap, tap-tap-tap.* Majnu's code, physically tapped out, something no spy program could intercept. Her hate flared red for a moment, before it was swallowed by loneliness. She stood up and opened the door a crack. Majnu was already walking away, head

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down, dejected. "Majnu!" she whispered hoarsely.

He spun and ran back to her, his face long and solemn. She did not open the cabin door fully but stood behind it, only showing her face. Majnu brushed his long black hair out of his eyes and stared at her. There was a long silence. "Your eyes," he said finally, "they're so red."

"I've been *crying*, you lout," she said, halfway between a sob and a laugh.

Another long silence. Kazo stared into Majnu's face, her eyes so sharp and hard that he looked down at his feet. "Old Samraatju, my father, is here," he mumbled. "Aboard the *Umialik.*" He glanced down the corridor.

Kazo's naked arm snaked out and grabbed the edge of Majnu's loose tunic. "Come on, come in."

He sat down on the bed and she closed the door, snipping off the quavering quadrangle of light. "Dark in here," Majnu commented quietly.

"I like it that way." Kazo did not sit down next to Majnu, but leaned against the cabin door. She could hear Majnu's breathing.

"He's talking to your mother," he said abruptly. "About compensation for your sister."

"You say it so casual: *compensation.*" She thought of more things to say, hurtful things: *It's so like you superrich.* And: *As if she was just a commodity to be replaced if broken or lost.* And other things. But Kazo knew they were not really true of Majnu. He was not the one she wanted to say them to.

Majnu stopped talking. He just sat on the bed, breathing, like the sound of two silk cloths rubbing. Kazo stayed on her feet, her back against the cool smooth surface of the cabin door, her body seething and aching.

"Say something," she finally said. Majnu was silent. "Say something stupid, so I can hate you. I need you to say something stupid so I can hate your entire family."

"You can do that anyway," he said quietly. "You don't need any words from me. You should hate me. Should hate us all."

"I want you to make it easy for me."

Silence, then: "Isn't it easy already?"

More silence in the dark. Kazo said, "No. You make it difficult."

"How?" Majnu sounded genuinely puzzled.

Kazo sighed loudly. "Don't be thick."

"Huh?"

Kazo closed her eyes—unnecessary in the dark, she thought for a moment—and said, in a tight voice, "Because, because you make it impossible to hate you. You, Majnu, despite who you are and where you come from and despite your family and your superwealth, you are kind and gentle and caring and sweet and thoughtful. Do you think you were adopted? Because no one could hate you. Not me. You make it difficult, Samraatju Majnu, because I've fallen in love with you." Kazo swallowed and licked her lips. She pressed herself against the door, her heart beating fast, feeling naked, feeling out of breath as if out in the vacuum of space without an environment suit or a blister.

She heard the sound of cloth rustling, and then she felt the warmth of Majnu's body and the salted perfume of his body as his arms enveloped her. He said nothing, and she loved him all the more for that, he stood next to her and wrapped his arms around her.

He held her for a long time there, in the dark, against the door, and he held her for a long time more as they lay together on the bed as she sobbed. He held her as they both slept. Then when they awoke, he gently kissed her face and all over, and they made love, and he held her again as they lay, naked and perspiring, on her bed.

Majnu nuzzled and kissed her bare shoulder. "Gojraan hates me," he murmured.

"What?"

"You said no person could hate me.

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Gojraan does. Of course, Gojraan hates ev—"

"Gojraan isn't human. He's a monster. Count his chromosomes, bet you find some terataploidy."

"Hmm, that's a good point. It makes me feel better. If he's not really human—"

"Feel better why?"

"Oh, I once tried to hire an assassin to kill him. I felt a little guilty later. And Father was *really* angry with me. Of course, Father's terrified of assassins—"

"Wait. You hired an *assassin* to *kill* Gojraan?" She suddenly became aware of her own, cool nakedness in the dark, and she drew the bedclothes up around herself.

"Oh, that was years ago. And the person I tried to hire wasn't a real assassin, but one of Father's own servants. Quite childish, really."

Kazo shook her head. "I guess what they say is true: that the superrich truly *are* different from, well, everyone else." She sighed. "And if you keep talking about Gojraan and plots to kill him and so on when we're naked—" she shuddered "—I *will* hate you."

A moment late Kazo sat bolt upright, gasping.

"What? What is it?" Majnu asked.

"Get out!" she shouted. "Apilak—on my link—she says your father knows you're here—get dressed, *lights on!*—" both blinked and shielded their eyes in the sudden glare "—hurry, some spy program, Apilak's already destroyed it, but, oh, hurry, get out, get out!"

Only half dressed, Majnu gathered his pants under his arm and went to slip out the cabin door. But when he opened it, there stood his father.

Kazo only saw Old Samraatju for a few moments. Later her mother came to talk to her. Haisho sat on Kazo's bed, her iron face solemn and serious and smeared with mourning white. But while her mother talked, Kazo remembered vividly Old Samraatju. A body of stick limbs and thick stomach wrapped in silk pleats. A face worn and crumpled behind cloud puffs of white beard and underneath a black Tarindhu skullcap, his skin pale and translucent and webbed with blue veins. Only his eyes, black marbles, seemed unfilmed by age.

"Kazo!" Haisho said sharply. "Are you not listening? Do you not understand how grave your mistake is?"

"*My* mistake? Majnu's not a child, easily seduced—"

"He is the flesh of his father, like his brother."

"So don't strike or sleep with either one?"

Her mother's face sagged and she sighed. "You should know better. And now, now that we have lost your sister . . ."

Kazo bounced to her feet, shouting: "Yes! She's dead!"

". . . and after I had warned you, when you struck Gojraan . . ."

"And Kumko died to save that, that, that selfish *blob,* that insignificant piece of shoe dirt! Is her sacrifice erased, forgotten, just because I slept with Majnu?"

Haisho sighed again and rubbed at her eyes. "You do not understand."

Kazo stared down at her. "What, old Samraatju's philosophy? I understand it. I see it clearly in the fear in his children's eyes. What I do not understand is why you give in to him." She knelt before her mother.

Haisho placed her hands, knotted and cool, on Kazo's face. "I do it only to protect you." She took a deep breath. "You do not realize the depth of Samraatju's anger. It is . . . irrational."

Kazo felt a sharp stab of fear in her stomach. "What is it, Amma? What does he demand?"

Her mother closed her eyes before replying. "He wants your memory edited. All memory of the boy removed."

Kazo recoiled. "That's ludicrous."

"In return, he promises . . ." Haisho's voice lowered to a cracked whisper, as she changed the tense of the verb, ". . . promis*ed* you will be safe."

"You *agreed?*" Kazo's words came out

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sharp and shrill, nearly hysterical. She pushed away her mother's hands and staggered back to her feet. "I can't stay here—I have to go—I'm sorry, I have to leave, Apilak will have to put me planetside somewhere, anywhere, *Apilak!*".

Haisho was standing now too, trying to grab Kazo's shoulders. Kazo shook her off, shouting, "Apilak! Apilak! Help me! Don't let them cut Majnu out of me!"

"I had to, I'm sorry, you don't know the old man, he would have you killed—"

"Don't touch me! Don't touch me! Apilak!" Wailing, Kazo crumpled into a corner of her cabin.

Haisho slowly crouched down beside her daughter. "I would rather he cut out my own heart. I would have offered that. But he agreed nothing would be done until after the supernova. Editing out is harder than editing in. It might damage your skills, and they need you to guide at the supernova . . . Kaz, please forgive your mother." She reached out a hand gingerly, as if to stroke her. But Kazo screeched and shrank away. Haisho withdrew her hand, then lowered her head. After a few moments she stood.

"We leave immediately," Haisho said. "The supernova is in a few days." She turned away, paused at the door. "To lose a few memories is better than to lose your life."

But at those words Kazo fiercely shook her head. *No.*

On the journey to Maishaitan, Kazo remained in her cabin. She spent most of the time in the dark, strapped to her bunk against the freefall through *attask*, her stomach in turmoil more than usual, crying, then raging against her mother, against Old Samraatju, and against Majnu for not standing up to his father, then crying again.

They stopped twice on the way, spun up the ship for gravity and meals. Haisho silently left them outside the door to Kazo's cabin.

The only one who spoke to Kazo was Apilak. Kazo tried to resent her as well, to blame the ship's captain.

And in some part I am to blame, Apilak agreed soberly. *I did not intercept Samraatju's spy program, which was stealthier than any I had encountered before, and it reported Majnu and you together. I am so sorry, Kazo . . .*

Kazo only sniffed as she lay in the dark.

I destroyed the spy program immediately, Apilak continued, *although it tried to escape. Samraatju was very angry with me over that. And he came very close to canceling our entire contract. I was very angry with him for introducing a spy program on my ship. I argued with him, tried to argue with him on your behalf, on behalf of you and Majnu*. Apilak sighed, like the rustling of leaves. *He is old and calcified and does not see the need to listen to opposition.*

Kazo snapped, "Careful, Apilak, he might have another spy program listening in."

Oh, he does, Apilak replied, and Kazo's heart froze. Apilak continued: *We argued over the contract, for a long time. He has very clever advocates, and he pointed out that the contract can be interpreted as allowing, "for security," spy programs to monitor any activity relating to him and his flesh. Which includes his children.*

"You could cancel the contract."

Haisho and I considered that. It is not a simple issue. Samraatju's contract with us is very exacting. When we signed it we, meaning your mother and I, agreed to Samraatju's penalty terms for abandoning service without reason. After all, a supernova is a rare event and he would be unable to find . . .

Kazo interrupted. "'Without reason'?" She did not suppress the venom in her voice.

According to the terms of the con-

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tract, yes. And the penalties for abandoning the contract are severe, so severe they would not only impoverish me—I would lose the Umialik*—but also* your *family as well, to a degree you do not seem to appreciate. Your mother* had *instructed you to read it.*

"So," Kazo said, the words clumped in her dry throat, "it's a choice between abandoning the contract and abandoning me."

Haisho and I are trying to save you.

"You'll be saving only part of me!" Kazo shouted. "They're going to cut him out of me! Do you understand? The good girl may be saved, the dutiful daughter, maybe that's what Amma wants, but the part of me that loves, that laughs, that smiles, the real part of me—you're abandoning that! Just like Kumko!"

When she stopped shouting, the silence sighed, like the rustling of leaves.

As she plummeted toward the heart of the doomed star, Kazo closed her eyes. In the dark, she remembered Apilak's words, her sister's face, the touch of Manu's fingers on her skin.

After arrival in the system, the *Umialik* had looped tight around the swollen red giant star, a few million kilometers above the photosphere. Kazo waited dully in the deployment hold, waiting with Haisho, both heavily laden with self-sustaining supplies. After the supernova, the tourists would have to wait a month to travel far enough out to be picked up.

Haisho said nothing to Kazo. Kazo's entire body felt numb.

The Samraatju poured in through the hatchway, pulling themselves along handholds in microgravity: Sundshri and Kushri first, then Gojraan, followed by Majnu, who bounced off the edge of the hatchway and collided with Gojraan. Gojraan shrugged him off, quite unlike Gojraan, Kazo thought, underneath the weight of her sorrow. Then it became clear why.

Immediately behind Majnu came Old Rajraan, accompanied by two smooth-faced bodyguards. Even in the microgravity Rajraan moved slowly, hand over hand, looking like a shriveled beetle in his shell underneath all his supplies. But his eyes, dark and alert, watched his children as a spider does a fly. Rajraan merely glanced at Majnu, who flushed and ducked his head, ashamed of his clumsiness. The old man pulled himself beside Gojraan.

"See? Self-control is not so difficult," said Rajraan, his voice like coarse sandpaper. "Why then is it such a chore for you? Do you lack the proper proteins for discipline? Heh?" With a long, pale finger he poked Gojraan, hard, in the chest. "Tell me whose fault it is this time. Is it Majnu's? Is it? Tell me! Tell me!" With each demand he stabbed Gojraan in the chest with the finger.

Gojraan said huskily, "No."

"Then is it your sister's? Heh? Or your nanny long ago, whom you tormented? Is it your mother's fault? Did she lack the proper genetic makeup? Tell me! Is that it? Did I make a mistake in getting you on her? Tell me! Tell me who to blame!" He leaned closer to Gojraan. "That is a skill you inherited—finding blame."

Everyone stared at the walls. Even Kazo. She had imagined she would enjoy seeing Gojraan humiliated, but viewing the naked event she found she did not.

Apilak told them it was time to begin deployment. Rajraan did not pause but flapped a hand and continued his tirade against Gojraan. Apilak began to spin brane blisters, and one by one the group disappeared from sight. When it was Kazo's turn, the sharp prick of nausea as the blister enveloped her came as a relief. The walls of the *Umialik* vanished, along with the sight of the old man prodding Gojraan with his pale finger. Kazo began to fall into the sun, toward the core, a fist of dull violent flux that swam in a broad yellow-green sea.

Ahead of her were the other Sam-

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raatju siblings, a stream of faint silver bubbles each punctuated by bright beacons. Behind Kazo five more blisters ballooned into existence: Rajraan and Gojraan, the two bodyguards (Kazo hoped they had had training, or they would be more hindrance than help), and Haisho. The now invisible *Umialik* would be making preparations to fall across *attask* to a safe gravity well a few light years away. Elsewhere around the star other groups would be released by their ships, more superrich tourists in brane-shifted blisters, beginning the descent for the final pilgrimage.

As Kazo and the others fell, the burning layers of the star rose to meet and swallow them. They passed through the yellow-green veil of the hydrogen-burning layer, only to find another, brighter veil beneath. As the hours ticked by, they passed layer after layer: helium burning, carbon burning, oxygen burning, recapitulating the ontogeny of the star. Haisho spiraled around their charges, keeping them in a tight group, instructing them to brake and slow down. A few times Gojraan started to drift away, but a sharp, nasty word from the old man brought him back. It took most of a day to descend. This was the easy part.

And all the while Majnu was only a kilometer or two away, a silvery blister hiding him from Kazo.

Their speed dropped as they approached the final, tremulous violet fire that burned on the surface of the star's iron core. Here the silicon-burning layer deposited millions of tons of iron each second, adding weight to the death sentence of the star. The core was an impossibly hot, thick soup of iron, nickel, and manganese ions in a dense broth of electrons, far denser than any cold metal on the surface of a terrestrial planet. But iron cannot burn—no nuclear reaction on iron can release energy—and the weight of the layers of the star above pressed down on the core. In a short time the pressure would be so great the iron nuclei would be forced to swallow their own electrons, converting to nearly pure neutron matter. And the core would implode and fall away.

Inside her blister, Kazo was panting. It was not from the thought of the enormous densities, temperatures, and pressures a few centimeters from her fingertips. It was the pressure of the knowledge that after she left the star her memories would be edited, cut out. She would have at best a hazy recollection of this expedition, or perhaps none at all. That is, of course, if she even survived the supernova.

"Then why survive?" she whispered to herself.

Suddenly Kazo became aware of her mother's sharp voice. She looked around. But everyone was in a tight stream; no one seemed to be in trouble. Then she heard the smooth rumble of the voices of the bodyguards, and saw their blisters spread wide and rise above the rest. Kazo twisted her head around and saw, coming out of the hazy yellow glaze, the faint shadow of a blister falling rapidly after them.

A moment later the intruder bounced off one of the bodyguards, leaving his blister vibrating wildly. *Assassin!* the bodyguard cried.

And indeed the intruder was now heading straight for old Samraatju Rajraan.

Extinguish your beacon, sir, Haisho said swiftly, then added as the two bodyguards swarmed the assassin, *Kazo, get the rest of them out of here!*

Kazo called out, *Follow me. We need to fall deep, and quick!* When the Samraatju seemed to hesitate, Kazo barked, *Kushri! Pull in your limbs! Tuck in tight. Let yourself fall at least another five hundred kilometers.* To Kushri's credit, she immediately did as Kazo ordered. Majnu and Sundshri followed. But Gojraan spread wide his blister and he snapped upward, toward the skirmish, where the bodyguards banked in tight circles, battering at the ghostly intruder.

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Gojraan! Kazo snapped, then regretted it. Let him get himself killed, she told herself.

But Old Samraatju's beacon snapped on. *Don't try to play hero, boy, you'd only get me killed instead.*

Sir, extinguish your beacon, Haisho insisted, and again it blinked out of existence. Kazo was now so deep she could no longer make out Rajraan's blister, hidden by the glare of the neutrino flux. Her mother added, *Gojraan, follow Kazo. Now!*

Gojraan folded up and fell swiftly, catching up with Kazo and his sibling in a few minutes. They were slowing anyway, the viscous flux impeding their descent. Kazo told them to tuck in tighter. *Let's get to the edge of the iron core as soon as possible,* she told them.

Gojraan pulled level with Majnu, who was less than a hundred meters from Kazo. *It was you, wasn't it?* Gojraan asked, his tone knifelike. *You arranged for that assassin, didn't you? I always suspected you might try to kill Father, after all the times you tried to kill me—*

That's stupid, Gojraan. What would I gain? I will inherit almost nothing.

Your freedom, that's what you want, freedom to go off with your kak dog bitch. . . .

Kushri suddenly cut in. *Oh, Gojraan, you think you are so smart, but you know what? You really are as thick as a fish. If Father dies, Majnu will be under the little finger of Eldest Brother Shanraan. As will you and I, and . . . and it doesn't matter, we're going to die in the supernova, don't you know that yet? If you were smart you'd know that. That's the only freedom we'll have: death. When we're dead, we won't have to obey.*

And with that, Kushri tilted and curved away.

Sundshri shrieked, *Kushri! Come back here!*

Freedom! Kushri called back. And she extinguished her beacon. In the thick flux the shadow of her blister was nearby invisible, even up close.

Kazo! Sundshri said frantically. *Get her back!*

Despite free fall, Kazo's body felt as thick and heavy as lead. I won't make it, she thought. I'm already exhausted. Aloud she said, *Kushri's right. We will all die here. There's no need to try anymore.* She pulled in her limbs and plummeted past all the others. She did not extinguish her beacon. Let them follow if they want, she thought.

She fell.

She was now very close to the silicon-burning layer. Kazo saw waves of brightness shiver across the core, like wind on wheat. The beauty, unlike anything Kazo had ever seen before, warred with her pain and her anger. Should I die clinging to my rage and my grief, she wondered, or embrace the beauty? She stilled her mind, let loose some of her emotions. Perhaps I *am* maturing, she thought, and then laughed at herself, laughed for Kumko who surely would have teased Kazo's self-importance. As Kazo raced over the surface of the core she thought, I shall be like this starscape, a layer of quiet calm over deadly violence. But I will not completely let go of my pain, lest I be tempted to repent and return from the supernova to an empty life.

Slowing, she came to rest on the wavering silicon-burning layer. There was no sign of any other humans in the sea of brightness that surrounded her. I'm so tired, she thought. Here I can lay my head and sleep. I can be at peace. I *am* at peace. . . . Kazo closed her eyes, drew her legs and arms tight against her body; her blister began to sink . . .

Kazo. Majnu's voice.

Kazo's eyes opened. She threw out her limbs and she tacked up and out of the violet sea lapping at her blister. Far off she saw Majnu's beacon pulsing as he approached.

I was afraid I had lost you.

I'm still lost, Kazo said sourly, although she felt a tick of joy in her heart.

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She could not see Majnu's face, but hearing his voice she could imagine it, could imagine his fingers brushing against her skin, imagine his long dark hair tickling her face. *After this they will cut you out of me. I'd rather die . . . I* will *die instead.*

Don't talk like that. I don't want you to die.

I'd rather die with you inside me than live with you cut out.

But Kazo . . .

Listen, said Kazo. *The core will soon collapse. Let's not spend our last minutes wheedling and arguing. You must let go of me. You must. If I die, maybe your father will be appeased and he won't cut me out of you. You can remember me, if you wish, for all the centuries of your life.* They were both silent as the seconds burned away. *If only I could see your face one last time,* she said.

If only I could kiss your lips once more, Majnu replied. *I won't leave you, even if it means death.*

Don't be idiots, said Kushri's voice. Kazo looked up and around. Kushri's beacon was a spark just a few kilometers above the rippled veil of the silicon-burning layer. As she spiraled toward them she said, *All this drippy romantic talk of death and centuries. I don't know about centuries, but listen, you haven't heard the plan yet.*

Plan? Plan? What plan? Kazo asked.

Kushri laughed. *Apilak's plan. And your mother's—she's in on it too. You're supposed to 'die' . . .*

Um, Kushri?

Let me finish! Not really die, of course, you silly fish. You just won't come back with us. Everyone will think you died. Especially *Father. After the supernova, head toward galactic south. Apilak has arranged for a friend to pick you up.*

Kazo's heart beat faster. *Really?*

Sure, of course, what do you think? Haisho told me. Father's spies were watching the two of you, not me. And that 'assassin?' Just a clone drone that Apilak sent, an excuse for us to scatter. After the supernova, Father will think you two are dead and you will be free.

It might work, Kazo thought. But then a shadow passed in front of her, and the blood stopped in her veins.

Someone else is here, she said. *Look!*

It was just a cold spot against the purple fire of the silicon-burning layer, so faint she had to squint, but then it shot away purposefully. That was a mistake; the blister was easier to follow when in motion. Without hesitation Kazo leaned forward and sped after it, catching up in moments. She swerved in front of it, all the while thinking, In a few moments the core will collapse, in a few moments the core will collapse. When the blister with the unlit beacon refused to slow or turn, she rammed it, not hard, but enough to make her own blister shudder from the impact. The phantom slowed and began a lazy turn back toward the others.

Who are you? she demanded. When no answer was forthcoming, she charged the phantom again. It dodged, and a beacon sparked into existence.

Leave me alone, you dog bitch! came Gojraan's panicked scream. *You both* should *die! Wait till Father hears of this! About your treachery, and the betrayal of that kak machine, and my dog of a sister . . .*

Listen, Gojraan, Kazo said quickly, trying to keep desperation out of her voice. *You could come with us. You could be out from under your father's little finger.*

There was a slight pause; then Gojraan said, *But I would get nothing. Nothing!*

What will you inherit now? Even this loyalty won't impress him.

There was a long silence. Ahead Majnu and Kushri bobbed in the neutrino flux.

He'll find out, Gojraan said, in a small voice. *Somehow, he'll find out, and he'll find out I knew and didn't tell,*

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and he'll punish me terribly, he'll kill you, *but my punishment will be worse than death.*

Gojraan, no, listen, there must be a way . . .

He'll find out! Gojraan insisted. *There's no escape!* He began spiraling up and away, but before he completed his first turn, Majnu had slammed into his blister, full on.

Stupid dog! Gojraan screamed. *You'll kill us both!*

We were planning to die anyway, Majnu said.

Gojraan banked sharply. *Go ahead and die then, the two of you. Just leave me out of your suicide. I'll piss on your graves.*

Oh no, said Majnu, *You'll die first. You won't tell Father anything.* And his blister slammed again into Gojraan's, hard, leaving both shuddering and shaking.

You're crazy! Gojraan cried.

Majnu's blister twisted, down down, and then soared back up. Gojraan dodged to one side, just out of Majnu's path, and then immediately slammed backward, catching Majnu off guard. Kazo screamed. Majnu dropped like a stone, but Gojraan pursued him closely and *wham wham wham* hammered his blister against Majnu's.

Kazo's mind felt paralyzed. She was watching herself almost as much as she watched in horror as Gojraan battered Majnu's blister. The thought, *I have to do something, move,* just began to crawl across her mind, when suddenly she found her body and limbs moving as of their own accord. Gojraan's blister loomed large and she braced herself in the last tenth-second before they collided. The surface of her blister shook, her hands and arms trembled, and perspiration poured down her forehead as she steadied the instabilities.

Gojraan was knocked up and out of the plane of the silicon-burning layer, and Kazo expected him to turn and run again. But before Gojraan could steady his instabilities Majnu slammed into him again. *Help! Help! Murder!* Gojraan shouted.

The back of Kazo's head felt full of ice. Her vision flashed red, and as she dove toward Gojraan the words came out of her mouth, *You murdered Kumko. You as good as murdered her.* But she was thinking of Majnu.

Kazo collided with Gojraan, sent his blister tumbling. She spread her limbs as wide as she could and looped up, then tucked in tight and dove down, down, building up vee, aware that the black cold space that was her heart knew exactly what she was doing,

Kazo rammed Gojraan, driving him deep into the silicon-burning layer. The shock made her vision go black for a moment, and she was sure she would be unable to steady her own instabilities. *Let me die as long as he dies with me.* As from a distance she heard Gojraan screaming in frustration. She shook her head and saw, even in the soupy flux coming from the core, a dorsal instability on Gorjaan's blister balloon like a black abscess. Her stomach twisted like a wet rag, and she thought she might vomit.

A fraction of a section later the blister shredded and winked out of existence, slicing off Gojraan's final, awful noises.

Kazo stared for an instant at the spot where Gojraan had been—not even a stain remained. Her own blister shook violently, and again she thought she was going to die. Perhaps I deserve to, she thought, as much as Gojraan deserved to.

From far off, she heard the sound of Majnu's voice. She closed her eyes, breathed deep, and damped down the instabilities. Her skin was slick with sweat, her own body shook violently, and deep inside she felt a blackness. She wondered if this blackness would come between her and Majnu. If they survived.

Majnu drifted close to her, only a few

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meters away. *We had to, Kaz,* he said.

I suppose.

Oh, it's good riddance, said Kushri. *None of us will miss that little piece of trash. I doubt Father will even remember his name. Listen, there's only a few seconds, and I should try to find the others. I hope* I *survive. . . . Good luck, you two. Remember, galactic south. Maybe I'll even see you someday. Majnu, you're the only one of us I would miss.*

Kushri's blister smoothly skated away across the surface of the silicon-burning layer. She's gotten quite good, Kazo thought, pleased. A few moments later the spark of Kushri's beacon was swallowed up in the dense flux, which grew thicker with each passing moment.

Uh, is it almost time? Majnu asked.

Yes. When the shockwave comes, draw in your limbs. Don't fight it.

There was a long silence. *What will it be like?* Majnu asked.

Haisho told you: the core will fall away, and an instant later a wall of light, brighter than you can imagine, will hit you. Fortunately off the brane the acceleration will not affect our bodies as much. We will surf for about ten or twenty minutes; it will feel like forever; in that time we will be well outside the original surface of the star. . . .

You know, it will be ironic if we die anyway.

Well, let's not do that, all right?

All right. Kazo?

Yes?

I love you.

And then the core fell away, the world changed, and their journey began. ■

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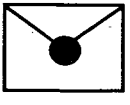

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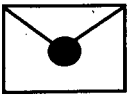

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Finding Planemos

Kevin Walsh

Planets without stars may be much commoner than we thought.

In August of 2006, a *Science* magazine article by Ray Jayawardhana and Valentin Ivanov reported the discovery of a two planemos orbiting each other about 400 light-years from Earth. A planemo is a generic term for an object of planetary size, one that is large enough to maintain a roughly spherical shape but small enough so that fusion processes can never occur in its atmosphere. One of the planemo twins had been found earlier, but the *Science* article announced the detection of a small companion, about 240 astronomical units[1] away. What is exciting about this finding is that while neither object appears to be associated with a known star, and other isolated planemos have been detected before, this is the first time that an entirely planemo system has been found: in other words, a non-stellar system with at least two members and probably more. Of course, if one such system exists, there are likely to be many others.

The lower mass limit of a planemo occurs for objects several hundred kilometers in diameter and thus includes all of the planets in our solar system, as well as many planetary satellites like the Earth's Moon. The upper mass limit of a planemo is about 13 Jupiter masses; objects somewhat larger than this are able to fuse deuterium for at least part of their lifetimes and are known as brown dwarfs. Brown dwarfs emit much more radiation than they receive, but unlike stars the great majority of this radiation is at infrared rather than visible wavelengths. Hundreds of brown dwarfs have been detected and many more await discovery.

Because the planemo twins were found in the constellation Ophiuchus,

[1] One astronomical unit is the distance from the Earth to the Sun, about 150 million kilometres or 93 million miles.

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their system has been named Ophi1622. Based on the observed infrared emission of the planemos and numerical models of their evolution, the discoverers conclude that one of the planemos is about 14 times as massive as Jupiter, the other about seven, and that they are very young, only about a million years old. Strictly speaking, the larger of the two might be either a small brown dwarf or a large planemo, but the smaller one is certainly a planemo, one of many more waiting to be found wandering between the stars.

It's been obvious for some time that there are more objects outside of the traditional solar system of major planets and asteroids than had been previously believed. The Kuiper belt, just beyond the orbit of Neptune, contains the bits and pieces left over from the formation of the solar system; within it, there are perhaps 80,000 objects with diameters in excess of 50 km. In the more distant Oort cloud, the repository of comets ejected from the solar system during and after its formation, there are likely to be millions of such objects. A possible member of the Oort cloud has been found already: Sedna, a dark red world some 1500 kilometers (900 miles) in diameter. Sedna's orbit is very elliptical, so its distance from the Sun varies greatly, from 76 to 975 a.u. There is considerable argument about how such an unusual orbit could have been established in the normal process of solar system formation. One intriguing possibility is that Sedna was perturbed into this orbit by a large undiscovered planemo circling between 1,000 and 5,000 a.u. from the Sun. In any case, Sedna is hardly likely to be the last body of substantial size to be found outside of the orbit of Neptune.

It has also been known for a long time that there are many small comet-sized objects and larger planetary fragments wandering aimlessly in interstellar space, the rejected offspring of solar system formation, ejected from their parent star by gravitational interaction with larger bodies. Simulations of planetary formation all agree that numerous small asteroids and comets, as well as larger planemos, were thrown out of the newborn solar system by the giant planets, particularly Jupiter. It is possible that several planemos the size of Mars or Earth were ejected from our solar system before the existing planets were fully formed and took up their current orbits.

As usual, speculative fiction has anticipated some of these ideas. The idea of a "rogue planet" traveling through interstellar space unattached to any star has been around since at least 1932, when Philip Gordon Wylie and Edwin Balmer published their novel *When Worlds Collide,* about the havoc wreaked by a pair of rogue planets entering the solar system. The book was made into a movie of the same name in 1951, winning an Oscar for best special effects. Apparently, Steven Spielberg is preparing a remake to be released in 2008. Several other science fiction stories and novels have set at least part of their plot on interstellar bodies, that is, objects between the stars. But even if a couple of rogue planets were headed our way, they would be quite difficult to detect until they were relatively close to the solar system.

Likewise, interstellar planemos are very difficult to find with current techniques. Direct imaging, the technique used to find Ophi1622, can only see close planemos or those whose temperatures are high enough to emit significant amounts of visible or infrared radiation. Young planemos are hot and bright but then cool rapidly, whereas the more massive brown dwarfs start out hotter and cool slower. Thus bright objects can be of various ages and sizes: planemos with masses only several times that of Jupiter must be less than 100 million years old to still shine strongly in the visible or infrared, whereas brown dwarfs can be much older and still be detectable.

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Another technique that can find interstellar planemos is microlensing. Microlensing relies on the deflection of starlight by the gravitational field of objects passing in front of stars. The resulting change in the light output of the star can be compared with theoretical predictions to obtain an estimate of the masses of such objects. Of course, this method can detect an interstellar planemo only once; after the initial contact, the planemo is impossible to find again, as it has traveled off in some unknown direction and cannot be observed by any other technique. This method can find a sample of smaller worlds and thus give us an idea of how many are out there, but it leaves the vast majority of interstellar planemos undiscovered.

So it is not a new idea that there may be some planemos drifting in the space between the stars. What is new is the thought that there may well be a *lot* more between the stars than circling around them, and that their types may be almost as diverse as those of planemos within the solar system.

Planemo types

How many interstellar planemos there are is hard to say. Interstellar space is huge: many readers will know that the distance from here to Alpha Centauri is about 8,000 times the distance from here to Pluto. That's an awful lot of room, more than enough to hide numerous Earth-size planets.

Nor would these planets necessarily be uninteresting frozen iceballs. For a start, some interstellar planemos about the size of Earth would be able to maintain surface temperatures well above absolute zero, perhaps even above the freezing point of water. In 1999, David Stephenson suggested that Earth-size planets ejected from the solar system during their formation might retain a considerable portion of their primordial thick hydrogen atmosphere. Earth had such an atmosphere very early in its evolution, before the Sun started to shine vigorously, emitting energetic radiation that then stripped away the light hydrogen molecules, leaving only denser gases behind. A thick blanket of hydrogen retained by a planemo after its ejection from a stellar system might be dense enough to trap the heat emitted from its interior, a process driven by radioactive decay and responsible for Earth's molten core. This might be enough to maintain a surface temperature above freezing. For a planemo with a more active internal heat source or a thicker atmosphere, surface temperatures would be higher. Worlds with significant active volcanism would also have numerous local regions where surface temperatures would be well above the freezing point of water, in hot springs, for instance. Such planemos might be reasonable places for primitive life to form.

Note that these planets would need to have very thick atmospheres to trap enough of the internal heat to ensure that the surface temperatures stayed warm. An Earthlike planet doesn't emit much internal heat. For example, the surface of the Earth receives an energy flux of about 300 watts per square meter on average from the Sun, but only about 0.1 watts per square meter from its interior. For an internal heat source of this magnitude, the planemo's hydrogen atmosphere would need to be thick enough to exert a surface pressure of about one kilobar, a pressure a thousand times that experienced at sea level on Earth and about as crushing as that at the bottom of our deepest oceanic trench. So even if these planets had life, they would still be very inhospitable to human beings. Manned exploration of the surface of such a world would be difficult: its atmosphere would become violently explosive when put into contact with oxygen, and its surface pressures would require spacecraft built like deep-sea diving vessels. It would be easier to set up a base on a barren piece of rock in the same interstellar neighborhood.

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A more hospitable place, at least for some forms of life, might be in the ocean of a water subgiant planemo. Water subgiants are a class of planet predicted by simulations of planetary formation but not yet detected. They are objects a few times the mass of Earth, covered in water oceans of variable depth, typically about 100 kilometers. Many such planets are likely to have active internal heat sources and thick atmospheres. These ocean worlds would be good locations for life, for the same reasons that the iceball satellites of Jupiter and Saturn, namely Europa and Enceladus, are high priority targets in the search for life in our solar system due to the presence of their subsurface oceans.

Even so, the life that could form on interstellar worlds would have considerably smaller energy resources available to it than on Earth. Since the average amount of energy received by the Earth from the Sun is about three thousand times as much as from internal heat, this means that life on interstellar worlds would be generally low energy. On Earth, plants are a relatively low-energy lifeform, and as a result, in their current state will never develop technology or launch spaceships. Human beings, by ingesting the energy content painstakingly gathered up by plants over a large area of the planet's surface, are able to live more active lifestyles and do creative things like build bridges and start wars. In contrast, life on a low-energy world faces an uphill battle to modify its environment in a significant way. Thus any such life will likely be immobile or slow moving.

Whether they host lifeforms or not, interstellar planemos may be almost as varied as the planetary types within the solar system. At the top of the planemo family tree will be behemoths more massive than Jupiter, older versions of the Ophi1622 system, swirling gas giants with brutal atmospheres, still emitting some infrared radiation even after billions of years, like Jupiter itself. Also like Jupiter, they will be accompanied by a retinue of close satellites, formed by the collision of planetary "embryos" agglomerated from smaller particles orbiting in the dusty disc that enveloped such giants during their birth. These satellites could themselves be quite large, just like the major moons of Jupiter. They could be as diverse as volcanic, sulfur-spewing Io, iceball Europa and cratered Callisto. Farther away from the giant planemo, there will be a collection of circling asteroids and comets, a mini-Kuiper belt of its own. Farther out still, there may be a loose and variable number of satellites of opportunity, passing comets that have been temporarily or even permanently snared by the gravity of the giant. There may be more of these big planemos in interstellar space than there are visible stars, perhaps considerably more. Certainly, current work suggests that there are at least as many brown dwarfs as visible stars, and the same may be true of large planemos.

Descending the family tree, there might be numerous interstellar gas giants of varying sizes, from Jupiterlike bodies to worlds smaller than Uranus. How many there are depends on how they originate. It is generally believed that planemos are formed by two processes: by gravitational collapse of a cloud of gas and dust, or by agglomeration from a dust disc surrounding a larger world. The lower mass limit of objects that can form in interstellar space from gravitational collapse has not been firmly established, but it is probably less than seven Jupiter masses, since this is the estimated mass of the smaller component of Ophi1622, designated Ophi1622B. Ophi1622B most probably formed by collapse, as it was likely too distant from the dust disk of its larger companion to have formed from it. It is possible that smaller interstellar objects formed by collapse may exist: a few dozen free-floating interstellar planemos

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have been discovered, but their masses, being estimated from spectra alone, are not precise. It is also not clear whether they originated by themselves in interstellar space from collapse or by agglomeration in a large stellar system and were then ejected. The Ophi1622 system itself was probably not ejected from another stellar system, as the two planemos are separated by such a large distance that they would have been too easily detached from each other during their violent exit from a previous system. If objects smaller than Ophi1622B can form directly in interstellar space by collapse, this would boost their potential numbers.

Clearly, though, objects of Earth size or somewhat larger should be relatively plentiful, since they would have been routinely ejected during the formation of stellar or large planemo systems. Those Earth-size planemos having thick primordial hydrogen atmospheres will enjoy fairly hospitable surface conditions for some kinds of life. But other worlds may have been ejected into interstellar space without their original atmospheres if they were tossed out from regions close to the star after the star began to emit significant amounts of ultraviolet radiation, thus burning off their hydrogen atmospheres. The temperature of these planemos will be much lower, approaching the surface temperature that could be maintained by internal heating alone, namely only 30 degrees Kelvin or so for an object with an internal heat source similar to Earth's.

If some of these smaller planemos were ejected as close binaries and manage to stay together during ejection, they might be close enough to each other to generate large tides. This would lead to internal heating caused by the friction generated by the stretching and straining of the planets due to their mutual tidal attraction. Although the amount of internal heat created would depend greatly on the separation, mass and orbital characteristics of the planemos, this process can provide considerable energy, as the volcanoes of Io and the geysers of Enceladus demonstrate. In addition, some Earth-size objects orbiting close to large, Jupiter-size planemos may also be tidally heated. On worlds where this process was important, geysers, hot springs, and volcanoes would be standard features of the landscape, as familiar as rolling hills or grassy meadows on Earth.

As for planemos smaller than Earth, there will be large numbers of Moon- and Mars-size bodies between the stars, and they will also have varying atmospheric and surface compositions. Some will be dry, desiccated desert worlds, vast frigid starlit Saharas with less water than Mars and with land surfaces the size of Asia; others will be covered from pole to pole in snow and ice. Some may have cooled so much that their initial hydrogen atmosphere has collapsed into a liquid hydrogen ocean surrounded by a remnant thin hydrogen atmosphere. But most will have one thing in common: they will be dark. Planemos within a few thousand a.u. of a star will have reasonable illumination: at the relatively close distance of 5,000 a.u., the Sun would be starlike but rather brighter than Venus ever gets and would cast noticeable shadows. Farther out, though, even interstellar worlds with clear atmospheres will usually only be lit by the sum total of all available starlight. This gives a reasonable but not ideal amount of light, as anyone who has ever stumbled along a country lane on a crisp, clear moonless night will attest. Planets with thick, cloudy atmospheres will be almost as dark as an underground cavern. The only light will come from lightning flashes, volcanoes, or maybe the dim phosphorescence of organisms floating in an endless sea.

There will also be an assortment of even smaller bodies between the stars: billions and billions of comets, asteroids, boulders, and general stellar system construction debris. The distances between

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the stars are so enormous, though, that these numerous small objects will typically be separated by millions of kilometers. Nevertheless, the gravitational influence of the large interstellar planemos and stars may sometimes force these smaller objects to cluster in preferred locations, creating belts of rock and ice that might become interstellar navigation hazards. Nor would such hazards be very easy to find with current techniques until a spacecraft was quite close to them. This poses a particular problem for high-speed interstellar craft, no matter what their source of propulsion or where they might be headed.

Destinations

Apart from providing another set of astronomical objects to explore, there are other implications if planemos are present in large numbers between the stars. If they are—and that is still a big if—they will provide new destinations for exploration. The distance to Alpha Centauri, about 270,000 a.u., is daunting for a practical exploration program using present-day technology or any technology that is likely to become practical any time soon. On the other hand, a large planemo that is 5,000 a.u. away is reachable by a journey of perhaps ten to twenty years using foreseeable technology, namely a fusion-powered rocket with a high exhaust velocity. Thus the technologies that are required to reach the stars can be tested, refined, and developed by deep-space missions to planemos. As scientific and technological breakthroughs are made, more distant planemos will be contacted, until perhaps the day comes when 270,000 a.u. doesn't seem quite so far after all.

Nevertheless, in order to launch a mission to a hypothetical planemo 5,000 a.u. distant, a method of finding such an object has to be found. Naturally, the larger the object is, the easier it will be to find. Many brown dwarfs are relatively easy to detect at stellar distances, provided that an appropriate telescope is searching the right part of the sky. To date, though, astronomical surveys have been unable to detect brown dwarfs with temperatures less than about 750 degrees Kelvin. Even a large planemo like Jupiter has a lower temperature than this: if Jupiter were located in interstellar space, it would have an "effective" temperature[2] of only about 100 degrees Kelvin, despite being much warmer deeper within its atmosphere.

A new space mission will solve this problem. The Wide-Field Infrared Survey Explorer, an orbital infrared telescope scheduled for launch in 2009, will be able to detect brown dwarfs with effective temperatures of 150K out to 10 light years, so large planemos and brown dwarfs should be well observed by this instrument. A number may be detected that are closer than the Alpha Centauri system. This mission will give us a very good idea of how many interstellar Jupiter-size planemos there really are.

Detection of an Earth-size body at even the relatively close distance of 5,000 a.u. will be difficult, however. These bodies will have rather low effective temperatures, about 30 degrees Kelvin or so, and correspondingly low infrared fluxes. NASA's proposed orbiting Microlensing Planet Finder will be able to conduct a census of interstellar planemos down to objects as small as 0.1 Earth masses, but again microlensing can only give a statistical distribution rather than enabling specific objects to be explored. If it is ever built, the proposed Overwhelmingly Large Telescope, a visible-light instrument with a mirror diameter of 100 meters, may be able to detect Earth-size planemos in visible light out to several thousand a.u.,

[2] The temperature that a perfectly black object must have in order to emit the same amount of radiation as actually emitted by the planemo.

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but not much farther away, and only if the telescope were pointed in exactly the right direction. Finding more distant objects of this size would need even larger instruments.

All of this means that Earth-size planemos may be numerous but practically unobservable unless they are relatively close to our solar system or in orbit around a larger object farther away. This is a pity, because they may be an important and diverse class of terrestrial planets. Perhaps one day, detection techniques and spaceflight technology will advance to the point where terrestrial interstellar planemos will become our testing grounds and our bases, our stepping stones to the stars. But how are we going to find them? And how are spacecraft going to avoid running into them? Any ideas? ■

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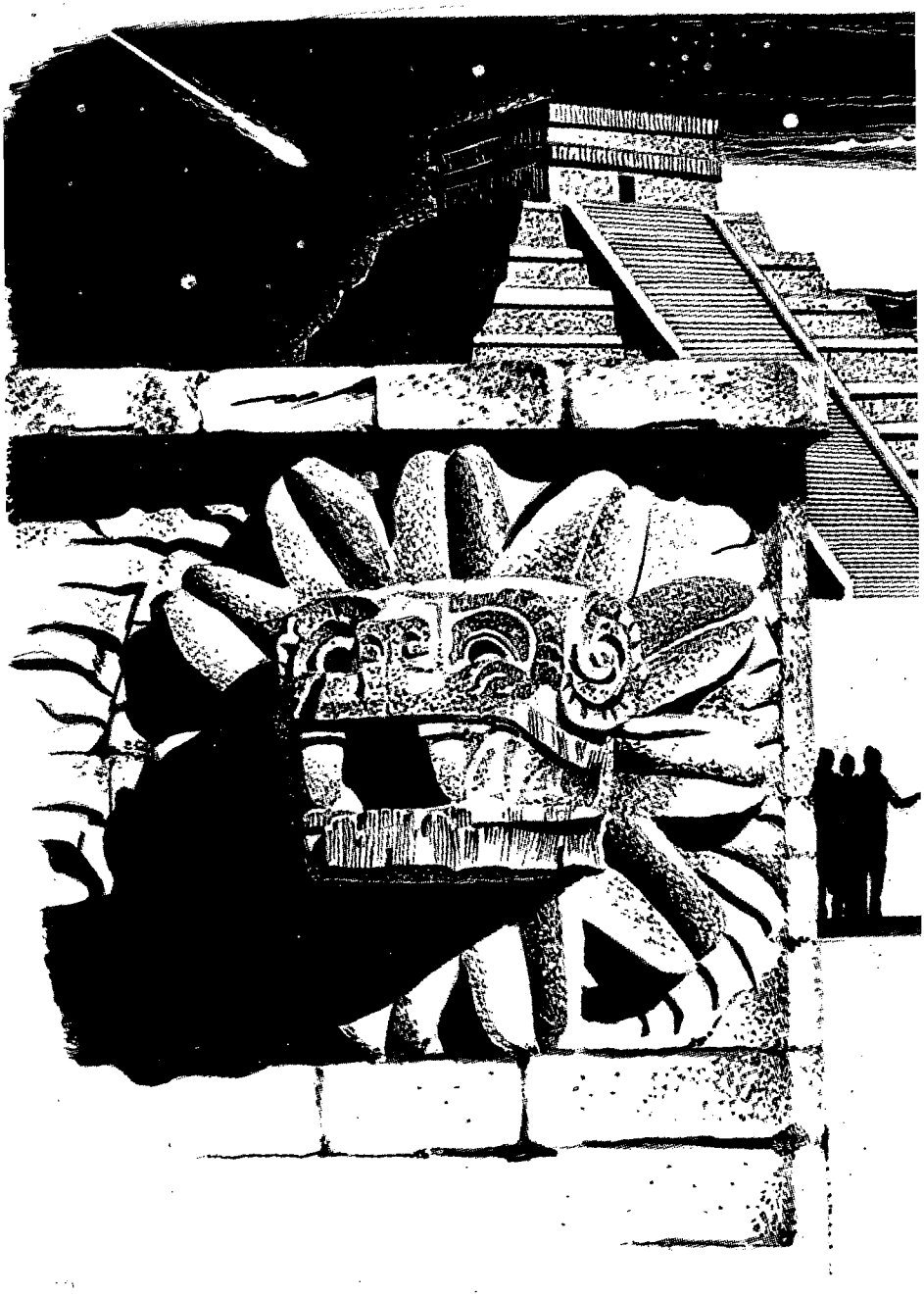

What people seldom fully grasp is that contact with aliens may involve things truly . . . alien.

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Kukulcan

Sarah K. Castle

Illustration by Vincent Di Fate

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"Our third winner is Pascual Teotalco. Mr. Teotalco is an American of Guatemalan descent working on a BS in astronomy at Vanderbilt. He is the first of his family to attend university. His intriguing proposal for the Fox Foundation's Message to the Stars Contest draws on his Mayan heritage." Dr. Leinster's voice filled the auditorium at the Arecibo Radio Observatory.

Crossing the stage, Pascual squinted at the few dim figures seated in the audience. He hoped Dr. Giocacci, the Arecibo student internship coordinator, was out there. He suspected his proposal was chosen mainly to add cultural color to Foundation's pool of winners. Fine with him. He'd entered their contest mainly to win the free trip to Arecibo and to meet the internship selection committee in person.

"Good afternoon, I'm honored to be here. Thank you for taking time to listen to our ideas on how to hail extraterrestrials. I know you all have full research agendas studying things currently *known* to exist outside our solar system and would like to get back to work, so I'll be quick."

This drew some chuckles from the audience. Pascual smiled and began, determined to keep his promise to be quick. He'd practiced the presentation six times before making this trip, timing himself to finish in exactly fifteen minutes. Knowing the protocol and sticking to it were important to making a professional impression.

The message he sent into space today was nowhere near as important as the one he hoped to convey to the internship committee. He'd placed his future in their hands. If he wasn't good enough for the Arecibo internship, he would be a good Mayan boy and move back home to Florida. He'd get credentials to teach high school science in West Palm Beach and live in the Mayan refugee community he'd come from. He loved astronomy, but he owed it to his family to start making money as soon as possible after graduation.

If he was accepted to Arecibo for the summer, then he would apply to Berkeley's astronomy program and work toward a PhD. Such a prestigious internship would convince his parents he was good enough to make a living as an astronomer. Right now, he needed to convince this audience.

"The beauty of my message is its simplicity and the inclusion of a critical mathematical concept: zero."

He progressed to his first slide, a photograph of stones and short sticks arranged in groups on a wooden deck. "Since ancient times, Mayans used sticks and stones, or dots and lines, to express any integer from one to nineteen. One stone was equal to one unit, and one stick was equal to five units. They expressed and manipulated numbers in the exact same way that we do today, using a place-value number system."

Advancing the slide, the delicate spiral face of a seashell filled the screen. "My Mayan ancestors, and the Olmecs who came before them, recognized the computational utility of zero, which they denoted as a shell. They used it both as an empty place indicator in a string of other integers and as a number in itself, used to indicate the absence of value."

"This discovery was made in Central America more than a thousand years before the Arabic numbering system that we use today was developed and came into use in Europe. Europeans studying our ancient documents were surprised to learn that Mayans and their predecessors used the concept of zero, allowing them to count to, and perform mathematical operations on numbers reaching to billions."

Pascual advanced to a photograph of an ancient calendar round carved into a stone stele. "And count they did, they counted days, observed the sky, and developed accurate solar and ceremonial calendars. We continue to count today.

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Our Long Count is 5,129 years long. It defines the current cycle of creation. This cycle will end on December 8, 2012, just five years from now. A rumor is spreading that we Mayans believe the world will end on this day, but you shouldn't worry! It's just the beginning of a new cycle. Go home tonight, sacrifice a chicken, and you'll get through it just fine." He wasn't joking, but he smiled at the audience to let them know it was okay to laugh.

"I proposed we send a message to the stars highlighting our understanding of zero. Just as the Europeans interpreted the knowledge of zero as a sign of higher-level mathematical thinking among the ancient Mayas, so might an alien culture be waiting for a similar signal from us. My message is simple and graphic. Not knowing how ET thinks or interprets radio waves, our message should be as simple as possible."

The next slide showed a string of dots and dashes in a line. The same sequence was arranged into a matrix in the center of the slide.

"The high and low frequency signals, I hope, will be interpreted as dashes and dots. When arranged in a prime factor matrix five places wide and twenty-three places tall, the frequencies arrange the dots within a field of dashes to form a diamond with an X drawn through it. This shape serves as a geometric visual break. It also has cultural significance to Mayan and Aztec people. The overlapping diamond and X pattern is frequently found in Mayan artwork and architecture. It represents the diamond pattern found on the backs of local rattlesnakes and symbolizes Kukulkan, known to the Aztecs as Quetzalcoatl, the feathered snake god who brought writing and mathematics to Mesoamerica."

"Below that, the symbols arrange to form an oval, which represents zero in many place-based numbering systems. At the bottom of the matrix, on successive lines, the length of the Long Count is written out to five places using the vigesimal, or base-twenty, place system used by the Maya. It will demonstrate our knowledge of zero and numerical place systems."

Pascual glanced at his watch and smiled. He'd spoken for fourteen minutes and thirty seconds.

His final slide showed the words "Thank you" in English and in his native Q'anjob'al. "In the three minutes this message is repeated, Mayans will speak to the stars after observing them for millennia. Thank you for this opportunity. Are there any questions, please?"

The dim auditorium was silent. Pascual looked over at his cowinners, who were still seated on the lit stage. The boy from Cornell squinted at him quizzically. His third grade classmates used to look at him that way when he amazed his teachers by quickly conducting long divisions in his head.

Dr. Leinster took the podium from Pascual. "Well, the Fox Foundation has certainly sent us a diverse selection of messages. Don't think I've ever seen sticks and stones on a slide in this auditorium before! Thanks for that Mr. Teotalco."

The small audience broke into a quick round of applause. Pascual's heart sank. They thought it stupid, maybe charming, but ultimately stupid. He sat next to the others as the applause wound down, but one person continued after the others had quit. Pascual searched the room and saw a woman with curly hair seated toward the back.

"Bravo, Mr. Teotalco! Thank you for your interesting proposal." Her voice filled the large room.

"Yes, well, all three winner's presentations have broadened our horizons today. Now we'll head over to the control room and send 'em out." Dr. Leinster gestured for the contest winners to follow him off stage.

As they filed from the room, the woman waited to walk out next to Pascual.

"Don't listen to him, he doesn't mean

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anything by it. He spends too much time with his data and not enough with people. Your idea is fresh, and your presentation was concise and interesting," she whispered as they rubbed shoulders in the aisle.

"Thank you, Ms.?"

"Dr. Anna Giocacci. You will hear from me soon, Mr. Teotalco." She smiled, shook his hand, and headed off down the hallway in the opposite direction.

Yes! Pascual pumped his fist for joy. He could make it as an astronomer! He watched Giocacci disappear around the corner at the end of the hall. He had to run to catch up with Dr. Leinster and the other contest winners.

In the control room, they stood among desks mounted with multiple computer monitors as the first message transmitted. Pascual's mind buzzed. The internship would strengthen his already solid application to Berkeley. He wanted a full research assistantship, based on academic merit alone, no minority-focused scholarship this time. It was now within his reach. The more he thought about it, though, his emotions scrambled. Graduate work would mean at least four years at Berkeley, away from his Q'anjob'al Mayan community and family in West Palm Beach. The four years at Vanderbilt already set him apart from his sisters and high school friends.

"Pascual, here goes your message." Dr. Leinster said.

Pascual nodded at him. If he tried to speak, his voice would surely crack. At this moment, Papa was picking oranges in a Florida grove. Mama was probably hemming someone else's pants. He sat in the control room of the world's largest radio telescope, speaking to the universe in Q'anjob'al. It felt futile and a little frightening, like trying to tell Papa about supernovae or explaining his belief in traditional day-keeping and divination to a fellow astronomy student. He was moving farther into a hybrid world, and it was lonely.

* * *

A Cheorka diplomat usually worked alone. But this mission was different in so many ways, the Universal Council decided to send a clutch. Their ship arrived in Earth orbit, shielded from detection by its plasmonic skin. The end of his preparation time rapidly approaching, Aranead again watched the five-thousand-year-old recordings of the Earth mammals made by the reconnaissance team. He'd been honored with the initial contact on this tragic planet and studied hard to do it justice. His three clutchmates watched recordings of Earth's more familiar creatures. They croaked softly together at the group sensorium on the opposite side of the ship's main nesting. They were pulling away from him already, and it hurt. Any one of them could have been chosen for the first contact, but his study, comparing mammalian husbandry techniques across cultures, put his name first on every Council member's tongue for this mission.

He couldn't help overhearing his siblings.

"They look like the Avidia of Alrai, in miniature." Wa'akon said quietly.

Aranead turned and looked at their screen. It showed a black, feathered being perched on a rock next to an ocean. Its sinuous neck and long, sturdy beak did look Avidian.

"It watches the water so intently, but doesn't smell the fish! We can smell them on the recording, but it just stares." Chika said, and the other two clucked in agreement.

"Look at its eyes! There's nothing but instinct, a vulnerable animal's primitive will to survive." Deekor chirped.

The creature finally comprehended the smell and its meaning. It pulled its head back, curving the neck into a graceful S-shape. Its pupils dilated for the hunt, and it crouched to take off. It launched; the clutch squawked.

Aranead forced his attention back to his own sensorium. The hairless mam-

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mals on the screen had dressed themselves in feathers, apparently to imitate the Cheorka recon team. Aranead's skin ached at the thought of so many feathers plucked. The creature's monotone speech, made with rubbery lips, sounded blurry to him. They sounded and smelled like livestock, but they didn't act like them.

"The recon team did an excellent job." Wa'akon approached behind him. "It's sobering to watch the archosaur tapes, to see what's left of them on this poor planet: Studying *them* will be instructive, but to spend so much time with these stumbling little creatures, interpreting their mumbles and growls, it must have been very difficult."

"It was, and will continue to be, difficult. It's time to face it. We can't ignore our responsibility any longer." Aranead turned to face Wa'akon, annoyed. Wa'akon was second to hatch. If she hadn't spent those years fishing on Cancri, her experience might have equaled Aranead's, and she could have been chosen for this honor.

"Mammalian intelligence, I can't imagine it." Wa'akon returned the aggressive gaze.

"We must imagine it, and we need to respect it as peer to our own. We should have stayed after the recon mission. The Earth creatures were clearly self-aware and took some teachings from the recon team. An archosaurid race at that developmental stage would have been fostered."

"They would have been fostered by a physically similar race. Who would foster mammals? The Universal Council debated this for over five thousand years, since the recon mission returned. Now the mammals call for us. We have no choice but to respond. We will invite them to Council, as we would any other race."

"It's going to be different. It's as if we killed the Avidia on their nursery planet, and the mice crawled from their dens and took over the world. It's as if the khulon . . ."

"That is what we did, broodmate. If you would have given our responsibility to the recon team then, perhaps you would pass it to me now?"

Aranead's hardened upper lip pulled back from his teeth and he used force of will to push it back down. Wa'akon was trying to help. If he passed this task to the second hatched, he would shame the lineage.

"You're worried about controlling your instincts, aren't you?" Wa'akon raised her feathered crest to a point.

"Of course I am."

"The instinct to feed?"

Aranead felt his crest start to fall and caught it. "Yes, that's it." He hoped Wa'akon hadn't seen his disappointment. She obviously didn't want to discuss the other instinct Aranead would need to control.

"Practice, then. Deekor! Chika! Aranead will practice the Contact Ceremony for us!"

Aranead's skin prickled. They wouldn't talk to him about how this mission would be different, only how it would be the same. Fluffing his breast feathers, he took a deep breath. The ceremony would be his salvation, his guide. Practice would help. Adherence to ceremony brought the Cheorka through millions of years with their culture intact. It would get him through the next couple of days.

He began the song. The meaning of the whistles, buzzes, and burrs would be lost on any but Cheorka, but the dance could convey meaning. Tucking his wings close to his body, he placed each foot rhythmically, walking a straight line to the first corner. There, he extended his neck to the right, toward the ground, and nodded, warbling and miming feeding. He turned sixty degrees to the right and walked an equal length straight ahead. There, he stopped, facing left, and spread his arms, extending fingers from his wing's leading edges. The one sharpened talon

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on each hand poked forward twice as he shrieked and mimed defense. He hopped to spin one hundred twenty degrees to the right, and then repeated these two sequences twice to surround the imaginary nest.

He pictured the nest in his mind and tried to imbue each movement of his body with the care and teaching, defense and protection intended by each vertex of the dance. But when he imagined the nest full of mammals, it fell apart. He stamped his feet and turned toward his clutch, who were nodding their heads in time with the song.

"How will they understand? They gestate their young inside their bodies, and then carry them along after they're born."

Wa'akon turned her head to one side. "We don't know that they will. What comes after the dance will be more important to their understanding. But until you see how they react, you must stick to the ceremony. They should at least recognize the pattern and its ritual aspect. For now, as when you are on Earth, you must follow and complete the dance."

Aranead nodded. This dance had inspired terror in beings across the universe over millions of years. The pebble-skinned Krokos of Centauri, the scaly Deenos of Cancri, the feathered Avidia of Alrai, all of them, and thousands more since, had submitted to the creed of the Cheorka and joined the Universal Council. The message, coming from the most feared predator in the universe, was very effective.

He would follow the prescribed ceremony. It had worked so many times before. Surely, something in it would help him on this battered planet.

Aranead danced with careful steps back from the final vertex of the pattern, to a place along the midline of one side. He snaked his head low, dropped his wings almost to the ground, and stalked straight to the center of the shape outlined in the first part of the dance. There, he mimed picking at the ground with his right hand and slashing with the left hand's single talon. He opened his mouth wide to show the full extent of Cheorka dentition, tossed the invisible morsel in, and bit down. Pick, slash, bite. Then he continued straight out of the nest and swung his wings forward, hands low and facing upward. Again, he imbued each gape of mouth and sweep of wing with their intended meanings of offering and acceptance.

Aranead could not imagine how creatures who carry their young for so long would interpret this last part, or how they would react when they learned its meaning. The ceremony, he thought. When all else fails, fall back on the ceremony. He was clearly on his own for what came after.

"Shh, watch, watch him!" Tomás whispered, grabbing Pascual by the wrist.

A roadrunner stalked a small rattlesnake through the mesquite not ten meters away. Pascual and his uncle sat in white plastic lawn chairs next to Tomás's trailer outside Nogales. It was a warm, still afternoon in January. They sat outside to enjoy the sun. Tomás squeezed his wrist so hard, Pascual thought it would crack.

The bird circled and feinted as the snake stood on its coiled tail, keeping its guard up while trying to retreat under a mesquite bush. After a while, the exhausted snake lowered its head to crawl off. The roadrunner charged. The snake lifted its head just as the bird bit down on its tail above the rattles. With a powerful swing of its neck, the roadrunner whipped the snake over its shoulder and smacked it hard on the rocky ground. It continued the beating until the snake was dead. The bird began to swallow the still twitching body before running off, half the snake hanging out of its mouth.

"Jesus, Mary, and Joseph!" Pascual spoke under his breath.

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"Welcome to Sonora, city boy. You don't even curse in Q'anjob'al anymore?"

Uncle Tomás didn't speak anything but, so Pascual switched, "Uncle, I've been at Berkeley for four years. The only Q'anjob'al I've heard has been over the cell phone."

"I can tell; you're searching for words right now. How will you remember the language when you live in Puerto Rico?"

"It'll be easier for me to visit home from Puerto Rico, a two hour flight. I'll have the money to fly home."

"When we go back to Guatemala, people won't trust you if you speak that way. They'll think you're trying to pass as ladino."

Pascual shifted, uncomfortable, the plastic chair flexing beneath him. "When will we go back to Guatemala? Mama and Papa have been planning to go back ever since they got to Florida, twenty-seven years ago!"

"It will be safe for us again this winter, when the new Long Count begins. The earth will shake and change. Only people who are right in their hearts will be left. Then we will go home."

"So I get my dream job just months before the world ends, great."

Tomás squinted at him from under the brim of his sweat-stained straw cowboy hat, lips pursed. "If the job is so good, it will continue when the New Count starts. You may still be in it if you're right with your family and the Mundo. Maybe that's the question we should ask: Will Pascual be able to stay in the clear light, with his ancestors and the Mundo, at his Puerto Rico job?"

It was time for the divination. Pascual could feel it in the stillness of the air, hear it in Tomás silence. He thought about all the questions he could ask, but the one Tomás posed summed it up.

"Do me the favor, Uncle. Ask that question for me."

Tomás nodded and took his hat off. He summoned the ancestors and the Mundo, the earthly world, by naming them in murmured prayer. He listed the sacred shrines and streams, the volcanoes and lakes of his pilgrimages. He borrowed the breath of the mist at the rising sun and the powers of the different kinds of lightning. The words flowed through Pascual's mind. He rocked and nodded with their rhythm.

On finishing the prayer, Tomás opened his *baraj,* the leather bag that held the tools of the day-keeper's trade. He sifted the seeds and crystals in the bag through his fingers, then pulled out a handful and blew on it.

"I now borrow the breath of this day. On this great and holy Wednesday, Seven Came, I take hold of these seeds and crystals to ask a question, a favor."

On a small plastic table between them, Tomás sorted dried corn kernels and tiny quartz crystals into almost two-dozen small piles. He arranged the piles into four rows.

Tomás began to count. Starting with Seven Came, he called each pile by consecutive number and the name of a Day Lord as ordered by the ancient divinatory calendar. His hand jerked slightly over the third pile.

"Nine K'anil, the deal is ripe, ready for the picking." He continued the count, resting his fingers on the next pile while saying its day name and number. "Ten Toj, and my blood speaks again, a tingling in my right hand. There is a debt owed to the Mundo, a big one!" He counted on. "Now, it is the Lord of Thirteen E' who speaks, you are guided on this road and will walk there in clear light." Tomás kept counting, but his blood did not speak again.

"Hmm, the answer is not entirely clear to me. Come here, Lord Thirteen E'. Will Pascual be able to stay right in the ways of his ancestors at this new job?" Tomás touched the seeds lightly and waited for the answer. "My blood speaks, this time in my thigh. Thirteen, the highest number of E', tells me you are strongly guided to take this road, but you must work hard to stay Maya in your

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heart."

"How can I do that, Uncle? I know I should call my parents more often. I'll try to get home for the feast days, but sometimes my work schedule will keep me from it."

"Those things are good. I think also you need to pray every day in Q'anjob'al. Each morning, greet the day by its sacred name, so you will always know your place in the divinatory calendar. Keep Maya symbols around you. Keep pictures of the temples, observatories, and artwork of our homeland at home and at work."

Tomás closed his eyes and let his fingers hover over the pile he'd counted as Ten Toj. "Yes, the ancestors already know. You will walk in the clear light as a Mayan man at this job, if you keep out of their debt by doing these things. The high number with Lord Toj still makes me worry that the debt is not just to the ancestors, but to the Mundo, that all the earth has a stake in you. Such a high number suggests that there will be a death."

The concern in Tomás's eyes chilled Pascual, despite the warmth of the morning. Would it be his mother or father? His sisters? Himself?

Tomás nodded, recognizing Pascual's fear. "We'll make an offering today. I think it will take a chicken, and you should leave me two dollars for candles to light at the statue of San Felipe of the Sacred Heart."

As they walked around the trailer to the chicken coop, Tomás asked, "What will you do at this job, anyway?"

"Watch the night sky, just like Kukulkan taught. I'll be looking for near-earth asteroids with the most powerful radar on earth, finding things that could become meteors, arrow stars."

Tomás nodded, "It's good to know about bad omens. You call me first when you see them." Tomás unlatched the coop. "Your Mama cried when she told me you got this job."

"She cried when I told her. She said it was because she was happy for me."

Tomás grabbed a big white chicken and handed it to Pascual while he got the knife from the shed.

"Use this board to rest its neck."

Pascual grabbed the chicken and held it upside down. He always hated this part. The chickens get so still and peaceful when they're hung by the legs. Tomás handed him the knife. Pascual rested the chicken's neck and breast on the two-by-six board lain across saw horses next to the coop. Tomás began praying, offering the chicken as payment to the Mundo on Pascual's behalf.

Pascual raised the knife. The chicken twitched in his hand. He turned away as he brought the knife down. The chicken squawked. Its body started to thrash. Pascual tried to pull the body free of the head and felt the two parts still connected under the knife. Eyes still squeezed shut, he sawed at the neck's muscle and bone, feeling the chicken's blood hot on his hand. The knife handle got slippery with it. The wings beat strongly; Pascual finally had to look down at it. His hand and the knife were a mess of white feathers stuck together with red blood.

"Why won't it die?" he shouted, and coughed to cover his retching.

Tomás grabbed the chicken, then the knife, and finished the job.

He clucked his tongue around the Q'anjob'al words, "City boy."

Pascual got on I-10 at Tucson. It would be three days driving to get home to Florida. The sun set in the rearview mirror. Uncle Tomás's divination rested his mind about his decision to take the job. But the visit overall had unsettled him. He'd been a teenager the last time he helped someone harvest their garden or put on a feast with his family. He knew his parents expected him to come home and live near them in Florida or in Guatemala, someday. Would it be twenty-seven years worth of somedays? As a student at Berkeley he still thought of himself as a visitor to the academic

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world. Taking the job at Arecibo, he would be making a home there.

He turned on the radio. The President was giving her State of The Union address. She said America needed to stop being mercenaries for the Saudi and Iraqi governments. Continuing the never-ending peacekeeping missions was draining the economy. The payment in oil still wasn't enough to feed demand. Every American would need to make some changes, some sacrifices, to end the dependence on foreign oil. Only through sacrifices could we regain the ability to choose our own futures, she said.

She was right. Pascual wished he could stay longer than a week at home, but his starting date at Arecibo was set. He wanted an anchor in his community and culture before the strong current of his life carried him off to his chosen future at Arecibo.

The clutch went over the glyphs, developed by the Cheorka diplomatic corps and approved by the Universal Council, for the initial communication with the humans. When they finished, the clutch was quiet for a few minutes. Aranead noticed their crests drooped around their faces. It was almost time for him to leave. He kept his crest at an alert point. It was an honor, he reminded himself, an honor. His stomach rumbled.

"On this planet of all places, it's probably a bad idea to show up hungry," he said, and they all laughed. "Let's have our last meal together, and I'll leave with a full stomach."

Every diplomatic ship carried livestock. The food habitat dominated the dining area, to provide the khulon room to move around. Aranead leaned over the cage to pick out a meal. The older ones had grown fat enough to eat. They were almost half a meter tall and covered with short silky hair. A younger one swung from the grate covering the top of the habitat. Aranead gently pushed the tiny pink hands off the bar and heard the creature thump, then scurry across the habitat's sand-covered floor. A nice, fat one looked up with dull eyes. It started a nervous shuffle toward a corner. Something about the creature's desire to hide whetted his appetite. The clutch squawked. Aranead grabbed the khulon with both hands just as it turned to run. His fingers locked around its torso.

Slashing its throat with a sharpened talon, Aranead said a prayer of thanks, then bit its head off and offered one leg each to Chika and Deekor. Licking blood from his fingers, he saw that some had dripped to the floor. He bent to lick it clean and saw a second fat khulon in the cage. It dug into the bedding in the corner. The little primate was too stupid to know its legs kicked frantically in plain sight as it dug. It was important not to start hungry today. Aranead grabbed both legs with one hand and pulled. Pick, slash, bite. He gave the other half to Wa'akon.

When the time came, Aranead boarded the shuttle ship, crest up. Wa'akon followed him in, and they stood together at the control console.

"You must succeed. By bringing them to Council, we clear the consciences of all Cheorka. And darkness only knows what those mammals will do if left on their own." Wa'akon scratched at the floor with her feet. "I was one who thought your mammal study inconsequential when you did it, and now it brings our clutch this honor."

Aranead nodded, noticing Wa'akon openly staring at the drawer with the wooden handle. It was an invitation to speak about its contents.

"I admit, I meant the study to be inconsequential. If I'd known the message from Earth was coming, and that I'd be chosen for this, I'd have fished on Cancri instead." The feathers of his crest drooped over his eyes. "I am afraid, Wa'akon. I've overseen many sacrifices, but never . . ." he finished the sentence

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with a hiss.

"I'm afraid for you, my broody. We enforce and audit, but Cheorka don't carry out the law or submit to it ourselves. Our mission is unique, and the honor brought will be equaled with sadness. When the time comes, know your clutch fears with you. There is no shame in fear. But you must succeed." As she spoke, Wa'akon dragged her fingers gently through the feathers at Aranead's neck. Aranead accepted the preening and cooed like a hatchling until it was time to begin the routine.

In taking flight, the plasmonic skin of Aranead's shuttle redirected a wide range of electromagnetic radiation around the egg-shaped hull, rendering it invisible to both the human eye and radar. With a more advanced saurid culture, he would have traveled visible to the first contact. Then more of the population would become aware of the visit before he landed. With these creatures, so strange but familiar in the most disturbing way, he did not want to be met with too large a crowd. He would appear at the facility that sent the message and deal first with the people there. The images they'd obtained of the transmitter's location suggested it was not densely populated.

As he fell toward Earth, he thought about the part of this mission he feared the most, the only part that could not be rehearsed. The island chain came into view. He hummed the Contact Song over and over, knowing this mission would end in silence eventually.

Pascual arrived back at Arecibo at lunchtime. As the afternoon heat faded, the rich smell of the jungle surrounding the giant dish filled his nostrils. Puerto Rico's lush greenery was so different from the swampy thicket of Florida. He imagined the jungle here would be similar to Guatemala's; it was close to the same latitude. After almost a year, Arecibo had begun to feel like a home in some ways. He had a comfortable apartment in town. The jungle reminded him of his parents describing their once and future homeland. It could be uncomfortable when Puerto Ricans assumed he was Mexican and began to speak quickly in Spanish. In social situations, he could explain that Spanish was not his native language, but in more casual interactions, people often thought him rude.

His colleagues treated him with respect. Pascual's work ethic and attention to detail were excellent. So much so, he felt it alienated the less prolific research associates, the ones who liked to joke, in his presence, about ethnic diversity hires. The jokes spurred Pascual to work harder. So hard he hadn't been home to Florida yet. He decided not to leave Arecibo until he'd drafted his first paper.

Pascual headed for the picnic area outside the cafeteria for a quick meal. The chicken asopao served here was delicious. He could practically taste the succulent chili and onions. The chicken would be so tender from the slow simmering, it would melt in his mouth.

"Evening, Janet," Pascual greeted the graduate student sitting by the cafeteria door. Janet looked up, smiling, but then her face went blank. Pascual wondered if he had said something wrong until the low frequency rumble shook his bones. His legs collapsed and he fell to the ground. He struggled against the vibration to get up. About twenty people sat stock still at the picnic tables, staring at the parking lot, where a metallic egg-shape, about five meters tall, rested.

Stunned, Pascual saw his car, among others, crushed beneath it. The hatch silently slid open. A huge creature stepped out and landed on stocky bird-like feet. The skin on its muscular legs was blue and pebbly. The black feathers on its torso and haunches were iridescent in the sunlight. It stretched as if it had been cooped up too long. Five giant fingers, one with an oversized talon, flexed from the middle of each wing. It

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stretched its long, thick neck skyward. The blue skin there had a crossed diamond pattern repeated in black lines from the feathered nape to the base of its skull. Long red feathers stood up on the crest of its head, like a woodpecker's.

There were whimpers from the picnic area. Pascual saw people, fallen off the benches, cringing and crawling away backward on their hands and knees. The creature dropped its powerful jaw, opening its mouth to display giant, sharpened teeth. Its head swayed back and forth on the long neck. It began to sing. Trills, clicks, and warbles vibrated in Pascual's skull. His colleagues scrambled and ran for the forest, but he could not take his eyes off the brilliant snake-necked creature.

Aranead saw the mammals scatter and run. They were twice as big as khulons. His eyebrow plumes shot up. He felt which way the wind would take their scent and instinctively turned to start a downwind course. He imagined ripping their limbs off as they squirmed and screamed. This instinct was so long repressed he did not have a method to defuse it.

Restart the dance, you fool, restart the dance. The ceremony will hold you.

He sang the Contact Song at top volume, watching the ground where he placed each foot as he danced. Nothing could be more familiar. Every Cheorka practiced this dance from hatching. Diplomacy was in their blood. Aranead felt the song move his body through each step, swoop, and stretch he made.

Pascual watched in wonder as the beast began to dance. There was a pattern in the noises it made. Its movements were repeated and rhythmic. It was trying to communicate. Every muscle and bone in his body shook when the creature's feet hit ground, but his thoughts snapped into clarity.

His call was being answered. That simple message, built from a lexicon of numbers and symbols rooted so deeply in the past, was being returned from an unimaginable future. The plumed serpent had given humans the language of mathematics to communicate between the terrestrial and celestial worlds. Had it come now to teach something new? More excited than frightened, Pascual reasoned with himself. This was no serpent. It looked more like a partially feathered *Tyrannosaurus rex* with sturdy wings and hands. And if it was Kukulkan, it was early. It was only August 2012.

The alien walked a pattern on the ground, turning precise angles at regular distances. It was a diamond! The alien was dancing along a diamond path! The creature repeated the sequence four times, and then changed direction. It crossed the shape formed by its previous path and pantomimed a hunt, which ended in a small thing being eaten, then seemed to shrug with its arms out.

Pascual remembered the roadrunner. It had been so cunning, so quick and deadly. If this creature, who had the skills to travel across the universe, wanted to eat him, there was no sense in trying to run or hide. The alien kept dancing, though it looked toward Pascual's fleeing coworkers. It was too much. Pascual began to scream:

"Kukulkan! Kukulkan! Quetzalcoatl!"

Aranead finally stood still, relieved. He finished the ceremony and it had worked, for him anyway. He'd had to do it twice before returning to his senses. Still not quite trusting himself, he kept his eyes closed. The sight of the fleeing primates might tempt him again. A series of repeated sounds broke the silence. There were consonant clusters and glottal stops that sounded almost like Cheorka. A lone human stood not fifty meters away, shouting at him. It was trying to communicate with repeated sounds. The ceremony had worked

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for them, too. The communication would start here. Aranead jumped to the ship's hatch to retrieve the message sphere.

The creature looked directly at him and then jumped back into the hatch it had come from. Maybe it had been insulted and was leaving. An alien arrives, and people scatter into the forest like deer. Outraged at his colleague's conduct, Pascual ran toward the ship, yelling, "No, No, Kukulkan! Stay!"

If these aliens were Kukulkan's historical basis, no one would ever mistake him for a Mexican again. The world would open their eyes to the Guatemalan government's persecution of the modern Mayan people. He got as close to the ship as he dared, watching the hatch above him.

The ship's surface was dimpled. Looking closer, Pascual saw it was covered in a thin, gray honeycomb. Each cell was etched with thread-thin loops of chatoyant wire. It occurred to Pascual that no one had seen or heard this starship until the moment it appeared. What must these creatures know about the nature of light, space, and time? A starship. It was possible this ship could take him this afternoon to settle the argument of the origin of asteroid 2005 CR37's structural complexity. What other arguments could be settled with the technology inside this ship? It couldn't just leave. It couldn't.

"Kukulkan!" he shouted in frustration. He swore the name had gotten the alien's attention before.

The giant head appeared in the hatchway. The plumes on the top of its head fell forward when it looked down at him. It turned its head a little, the way birds do when they look at things close up. Pascual imagined the big teeth clamping down on both his legs and being whipped to the ground.

He could not be afraid. Too much was at stake.

Its mouth was so big. He realized he'd been stepping backward. Gathering courage, he tried again to speak the only name he could place on this creature.

"Ku, Ku, Ku . . ."

The creature hopped lightly down from the hatch, landing five meters from Pascual. Its hawklike feet were thick with muscle. He had to calm down. Closing his eyes, he counted days.

"One Quej, two K'anil, three Toj . . ." He continued through the twenty day names. Familiar as childhood, it calmed his mind.

When he looked at the alien again, it nodded, then began to reach toward him. The long, blue fingers slowly got closer. Black feathers brushed the ground. The single talon was huge and sharp. Pulled back from the hand, it looked poised to strike. Pascual's heart accelerated. He remembered the other instruction Kukulkan gave to the ancient Mayas. He'd taught that the gods required human sacrifice. The world blurred, then went black.

The Earth creatures were better prepared than he'd expected. They kept a diplomat at their radio transmitter. They must have been expecting an answer. The small human was obviously well trained. He was persistent. He repeated a simple message, careful to avoid misunderstanding. He'd approached the ship as though he wanted to come aboard. It would be easier for him to see the message sphere inside where the light was better. Aranead could set the sphere on the floor near the hatch. The human could sit there to watch it. He looked out and saw it still there, making those sounds.

They looked so much like khulon, though this one's actions showed an obvious self-awareness never seen in Cheorka livestock. He could control himself. He would bring it aboard. He glanced toward the door of the shuttle's dining area to reassure himself that it was closed, then hopped from the hatch to face the human. He reached toward the

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little creature, slowly. He kept his talon drawn back from his palm to reassure that he didn't intend to use it.

The man fell to the ground unconscious. Aranead chuffed. He'd seen this reaction before on other planets, with other creatures. The mammal's sympathetic nervous system apparently worked the same as every other sentient creature's. He gently picked the human up and jumped aboard. Aranead laid the human near the message sphere. Then he took a place across the room, behind the control console, to reduce any perceived threat. As he waited for the human to regain consciousness, he couldn't stop looking at the drawer with the wooden handle. The handle was unique on the ship, the wood carved to look like an outstretched Cheorka hand. The drawer held the ceremonial blade. If all went well, he would take that hand soon. The thought made every feather on his back stand up.

Pascual became aware of stiff lumps pressing into his shoulders and back. He lay on a floor covered in a rough woven mat. An acrid smell, like rotting papaya, filled the air. The alien stood behind what looked like an altar, across the wide room from him. Pascual's body went tense with dread. He rolled to hands and knees and sprang to a crouch.

The creature flicked a finger once at the side of its neck. It opened its mouth, but the lips did not move when it said, "I am Aranead, of the Cheorka, representing the Universal Council. Your name, please?" It spoke in American English, with pauses just a little too long between the words.

Pascual took a full minute to catch his breath. Then he pointed to his heart and said, "Pass-qual."

Aranead flicked at his neck again, raised his eye plumes and repeated, "Rass-qual." His lips weren't quite flexible enough to make the "p" sound. He gestured toward a spherical screen, as wide as Pascual was tall.

Pascual looked at the screen and a silent moving picture began. The pictures were line drawings, like a cartoon. A blue planet surrounded by the darkness of space resolved on the screen. Brown and green continents massed in familiar shapes, but their locations seemed wrong. The view zoomed past the planet into space, where two giant spherical ships engaged in a slow-motion battle. Each would fire what looked like a laser at a meteoroid near the other. The meteoroid would then sail slowly toward the opposing ship, sometimes hitting it and causing massive damage. The ships themselves did not move. One meteoroid sailed past the opposing ship and toward the planet. It hit in the ocean near a broad arm of land. Dust and vapor rose to cover the planet's surface.

The sequence on the screen accelerated. In an instant, the dust cloud disappeared. Blotches of dark green grew and shrank repeatedly on the land's tan surface. Pascual realized the shifting colors were forests and savannahs, growing, then dying off. They shifted and traded places on the landscape so quickly they looked fluid. More slowly, the seas retreated, revealing the location of the meteor strike: the Yucatan Peninsula. The giant oval crater had weathered and was mostly buried.

The rapid change to the landscape then stilled. Thick jungle covered what remained of the crater. The view zoomed in to the Yucatan's Gulf Coast. An egg-shaped ship, just like the one he now sat in, descended from the sky toward a cleared patch in the jungle. Figures, just dark flecks from this height, crowded a plaza between two stone pyramids. The figures resolved into human beings as the ship and the view drew closer. A shiver raced up Pascual's spine. His people's history was being flashed before his eyes. The screen faded to black.

"Ah!" Pascual cried out. He desperate-

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ly wanted to see what came next. It couldn't be over yet. He turned to see the alien's hands hovering over the altar. It stared intently at its surface and then raised its bright green eyes to meet Pascual's.

Pascual made a noise. Aranead looked up from the computer screen. He'd imaged and modeled the human, to include him in the next set of glyphs. The human stared at him wide-eyed. He was very impatient; the history glyphs must have just completed and already he wanted more. Things were moving along much faster than Aranead expected. This mammal was a quicker study than reptilians he'd worked with in the past.

The human would have to wait just a few minutes longer. Aranead raised his hand, slash talon stretched forward. Pascual screamed and curled up against the wall, and Aranead felt guilty. The creature was not a saurid, who could at least chance escape in a fight with a Cheorka. It was a little mammal. Of course it would be terrified at the slightest gesture. While the computer finished rendering the glyphs, Pascual stayed curled against the wall, trembling.

"Rasqual, Rasqual," he cooed, pointing to the screen. The sound visibly soothed the human. He sat up and looked at the screen again. Aranead watched Pascual's reactions. This part would be more difficult.

The screen showed the Universal Council chambers, a giant ovular room with a large multilevel stage in one quarter and a gallery extending from floor to ceiling on the remaining walls. The view zoomed in to show the individual boxes along the top row, the observer's gallery. Each box held seven beings from the planet depicted by a globe hovering in front of it. Some boxes were filled with a variety of species, others contained just one. Pascual made short, sharp "huh" noises as he saw the alien beings there. Most were saurid, though there were reptilians among the observing planet's representatives. Aranead wondered if the human noticed the total lack of mammals. Was that why he had wrapped his arms protectively around his body? He was ashamed to find himself wishing the little mammal would panic. If it was hopeless, he could justify returning to the clutch. But Pascual remained still and calm.

An empty box was shown close up. Earth was recognizable hovering before it. Pascual's model faded in, sitting in one of the seats. The rest of the seats were filled in with generic line drawings of Earth humans.

He turned the translator back on by flicking the switch embedded in the base of his neck.

"Representative, your planet is invited to observe at the Universal Council. After observation you may choose to accept the charter and join as full members. As members, the Council's technologies and libraries will be available to you. Commerce with other members will be encouraged and regulated by Council treaties. The charter chiefly requires that war on your planet be abandoned as a method of diplomacy. You must also agree not to wage war against any other planet, Council member or otherwise."

Pascual began to shake and bark. Water leaked from his eyes and ran down his face. Aranead didn't know the meaning of it.

"Do you understand me?"

"I do. I understand." He spoke while gasping for breath. "But I'm not the one to make this decision. You should meet with our leaders and tell them these things."

"You will take me to them?" Aranead pulled up a globe on their screens. The feathers on his back lay down a little. The wooden drawer handle still reached for him. He was glad to step away from it for a little while. "Point to the location and we will go there now."

* * *

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Involuntary giggles shook Pascual's body as the tension left him. The alien didn't want a sacrifice; he wanted to be taken to the leader!

With deep breaths, Pascual worked to regain his composure. "We need to let them know we are coming."

Aranead nodded, but didn't say anything. Apparently, the alien expected he would immediately arrange a meeting with the president or the State Department or somebody. Maybe he could call them? He grabbed his cell phone off his belt and flipped it open with no idea how to call the White House. Staring at the phone, he remembered another call he needed to make first. He dialed home.

Because it was the middle of the day, no one was there and the answering machine picked up.

"Mama, Papa, turn on the television to see the news. I'm with the alien. We're going to Washington. I'm safe. I'll call again after I leave him with the president." He spoke in Q'anjob'al.

Then he browsed for the White House phone number and called it. He got an automated message. They listed many options, all of them directed to tourists and visitors. Pascual listened through the entire list, praying the last choice would be *To Speak to An Operator.* It wasn't.

He flipped the phone shut and looked at Aranead, who asked, "What was the language?"

"Q'anjob'al, my native language. But I speak English when I'm not at home."

The red feathers that lay flat over Aranead's eyes stood forward. The alien scrutinized him, perhaps realizing Pascual was not the man he needed for this job.

"Home is where your clutch lives. Your clutch is not here?" Aranead gestured with a wing to the door.

"My clutch? Um, no, it's my family. Mother, father, and sisters, they live in a different place."

"Live? Live in a different place?" Aranead cocked his head.

"Yes. Maybe, as you are here now, without your . . . clutch, so I am away from my family. They work, eat, and sleep far from here."

"My clutch is far away, but I can sense them completely at any time using the sensorium." His long claw pointed to the alcove behind him.

Pascual held out the cell phone, "I can hear and speak to my family with this, sometimes." Nervous energy drained, his arms felt heavy. He stared at the phone. It was smaller than the palm of his hand and his family was often not home when he called. A low-frequency coo penetrated his body as a light vibration. It felt good, comforting. He looked at Aranead. The feathers on the crest of its head tipped down to one side. Pascual understood it meant to comfort.

"It is . . . sad to be away," Aranead said and cooed again.

Pascual said, "Yes," wishing he could coo back. "But now, we must contact the President." He moved to look out the still open hatch.

The people who'd fled to the forest had moved to its edge and now stared at the egg ship. A news crew had arrived and was setting up cameras. A woman with a microphone spoke with Dr. Leinster.

Pascual shouted, "Hey! Over here!"

Every person in sight yelled and pointed. The news camera, hastily hefted to a shoulder, aimed at him.

"It wants to meet the president. We will leave here to go to the White House soon. Tell President Stewart we are on our way." He shouted as loud as he could. The newswoman moved closer with her microphone.

"You can hear me?" Pascual shouted.

The woman nodded, "Loud and clear! Keep talking! What's your name? What's going on in there?"

"I am Pascual Teotalco. Please contact the president immediately! It wants to meet with her now! Is she in Washington?"

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The newswoman chopped her hand toward her crew; one man was on the phone already.

Pascual summarized what he'd seen so far until the crewman approached the newswoman.

"The president's office says the visitor is welcome to meet with the president. They beg you not to land at the White House. Have him put it down on the National Mall. The president will communicate with him there."

After he'd closed the hatch, Aranead pointed to the control console. "Please, point to the location."

Pascual looked at the place on the wall where the open hatch had been. Once closed, there was no outline to mark it. The rotten papaya smell was heavier in the air, and Pascual fought the fear tightening his stomach. This creature is kind. It brings only an invitation, he reminded himself.

"Please, Pascual, we need the location to begin traveling." Aranead extended his slash talon to beckon, then seemed to reconsider. He curled that finger into his palm and gestured with his whole hand. "Do not be afraid. I would not hurt you."

Pascual nodded, stood up straighter, and walked to Aranead. They stood together, not at an altar, but at a control panel covered in switches surrounding a round screen. North and South America were shown, as if photographed from space. He could point to any place, take Aranead to anyone, and tell him this was the president, an important world leader who would make decisions for them all. For a few seconds, he considered pointing to Guatemala. He'd have to take him to Guatemala City, to meet the president who persecuted his family. The alien would sense something was wrong if he took him to a Mayan village, especially after seeing the buildings and technology at Arecibo. No, taking him to the American president was the only thing to do.

He pointed to North America's east coast. The view zoomed in. Pascual touched the screen to zoom even further until he could point to the Mall in Washington, D.C.

"When will we leave?"

"We're already underway," Aranead said. "Pascual, there are things we should discuss, diplomat to diplomat, before I meet your president."

"I'm not a diplomat. I'm an astronomer, a scientist who investigates the universe."

Aranead nodded in a forward to back circular motion. "Did the diplomat run into the forest during the ceremony?"

"Ah, yes, I think he did."

"Why didn't you run?"

"You looked familiar to me. My culture, the Mayans, descended from the people you visited so long ago. Some of us still live in the place where the meteor hit. We have stories and pictures of a god who looked like you: Kukulkan. Later people called him Quetzalcoatl. I was fascinated when I saw you. I thought you were this god."

Aranead clucked softly. "To those who met us back then, the Cheorka were gods. Some in the Universal Council still regard us so. We prefer to think of ourselves as coordinators and caretakers. We hold the universe's conscious beings together; keep peace, seed, and nurture young races." Aranead clucked again. "Just as some treat the Cheorka as gods, I will treat you as a diplomat: because you act like one. I have several questions. I assume your answers will represent only your own opinion."

"I'll answer what I can."

"We assumed, because of the message you sent, Earth is ready to join the universal community. Is it correct?"

Pascual frowned, "I couldn't guess. We'd sent messages before and gotten no answer. It's a surprise to get an answer to this one. I think we'll need time to consider joining anything."

"The benefits are greater than you can imagine, and the cost is moderate."

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"Cost?"

"It is the same as we taught on our first visit to this planet."

Pascual's eyes widened. His jaw worked slowly up and down, but he said nothing.

Aranead cocked his head at Pascual's silence, "Do you not still practice sacrifice?"

"Well, yes, some people do. It isn't common."

"How many Earth men a year are offered?"

"None. No men. Those of us who sacrifice offer livestock."

"How can livestock be a sacrifice? Aren't they eaten? All creatures kill for food."

"They are killed in a ceremonial way. The blood is offered to the gods."

"The Universal Council demands the blood must be your own, of conscious creatures. It's been decided that one hundred and twenty humans a year should be offered from Earth, twenty from each of your six populated continents. The Charter provides guidelines for how these people should be selected and the Cheorka would audit each offering."

"Why do you need human sacrifice? It will be a very difficult decision for us. Most human cultures hold life sacred. I don't think many would agree to send innocent people to be killed."

"But isn't that what war is? Fewer people will be lost to sacrifice than if you continue to war."

Pascual thought on this. He'd been eighteen the year the second Gulf War began. Many of his classmates enlisted so they could get money to go to college. Pascual had worked hard to win a scholarship so he wouldn't have to go. They weren't exactly innocent in those days, but they were somewhat naïve.

Aranead continued. "The Universal Council's Charter holds that life is sacred. It also acknowledges that life and growth require death. When the two aren't equal, imbalances occur in technological cultures. When life must be offered voluntarily, it highlights its value. The decision to create a life becomes as important as the decision to take one away."

Pascual shook his head. "It will take years for the people of Earth to debate and decide this issue. Observation at your council and descriptions of the technologies we could share will help us decide."

"Before any human can observe at Council, there must be a sacrifice."

Pascual stepped back from Aranead, panic tensing every muscle.

"No, my friend, you could not offer yourself. We require it be a leader. Perhaps your president?"

Pascual's legs wobbled. He grabbed the control console's edge. "It will be her choice, won't it, to offer herself or not?"

"Of course, it has to be. If she declines, we will visit other world leaders to offer them the opportunity."

"It will take time for anyone to decide."

"Time is offered. We have found, in past first contacts, the continent offering the first sacrifice enjoys prestige among the others for many years afterward."

"It's lucky, then, that the American president gets this opportunity first." Pascual nodded slowly.

"It is lucky you met me, and that you take me to her. It wasn't luck that allowed you to approach me first, it was courage."

"Maybe, maybe it was courage, but it felt more like fate to me."

Aranead considered the meaning of the word fate in his own language. He found it similar to the agencies that chose him for this mission.

"We are of the same clutch, Pascual."

"What do you mean?"

"We are related in our service to fate, but we can determine some parts of the path before us. I want to offer you a

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place on the observing team. It is my right to appoint one of the members."

"I could go to the Council? I could visit the libraries and speak to the scientists myself?"

"If you accept."

"How long does it take to get there, and to get back?"

"About two years, relative time, each way."

"Would I be able to use the sensorium, to keep in touch with my family?"

"No," Aranead chuckled, "Humans will have to invent their own sensorium, one matched to your own senses. You would be able to exchange sound and image files."

"How long would I have to stay?"

"As long as you like. It's of no use to the Council to have observers who don't wish to be there."

"I need to think about it. It's a long time to be away from home. When do you need my answer?"

"When I ask you for it."

Aranead breathed deeply and took the carved hand. Opening the drawer, he removed a long blade from the cradle inside. It was slightly longer than the width of his neck. The handle was wrapped in pink leather.

"The Cheorka offer a rare symbol of good faith to Earth mammals. I am chosen to be sacrificed to gain your trust. My blood on this knife will signal that I have chosen an observer. My clutch is in orbit now, waiting for the answer. If you let my blood, it will signal your respect for me and your willingness to honor other races' traditions. It would make a positive start on Earth's relations with the Universal Council."

"I don't know if I could do it. I've never killed anything bigger than a chicken."

"Can you hold this blade?" Aranead held the sword out to Pascual.

The man did not reach for it. He shook his head and asked, "Aren't you afraid?"

Aranead breathed in, expanding his breast fully. "Of course I am. Cheorka are accustomed to taking life, but it is rare we ourselves have to offer it."

"Why do you have to offer it this time?"

Aranead cocked his head to look at Pascual with both eyes and was quiet for a while. "Do you remember the glyphs and recordings I showed you earlier? You may have noticed that all the creatures in the Council chambers were saurid, similar to Cheorka, or reptilian."

Pascual remembered the creatures who occupied the Council seats in the video. There were none with fur, none resembling humans at all.

"Pascual, the humans of Earth, alone, represent mammalian intelligence in the universe. On every other world, saurids or reptiles evolved into consciousness and higher intelligence. The meteoroid hit Earth at a critical time in archosaurid development here. Mammals were given an advantage that allowed them to develop in a way found nowhere else in the universe."

"Cheorka threw that meteoroid. My lineage threw it and remembered through a song sung for millions of years. The time has arrived for us to make amends to Earth's conscious beings and to the universe. This nursery's destruction opened our minds to the senselessness of war. The Long Peace started here has lasted sixty-five million years. The Universal Council and the Cheorka both are in debt to the humans of Earth."

Pascual was speechless. Observing at the Universal Council would mean living among creatures from the worst human nightmares, like the Cheorka. He'd already traveled far from his upbringing as a Catholic Mayan in Florida. This would be a much longer and stranger journey.

"It isn't required that you perform my sacrifice. I can let my own blood and your decision to observe at Council will remain your own. If you don't wish to go, you can appoint another person in

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your place."

Aranead balanced the sword in one hand, swung it toward himself, and drew it in front of his own neck. The feathers at his nape stood on end. He practiced the motion several times, until it was fluid and natural. Pascual watched the pantomime, feeling helpless as a child.

President Laura Stewart's face filled a huge screen mounted on the back of a flatbed truck parked near Aranead's ship.

"Pascual, could you exit the ship before me? It will signal that I am not threatening."

Pascual nodded, went to the hatch, and stopped. "I can't. It's too far for me to jump down."

"I will pick you up." Aranead reached for him. Pascual winced as the giant hands came close.

Aranead picked him up with both hands, clearing his mind of the khulon he'd picked up in almost this same way not so long ago. Pascual stared at the slash talons, and then closed his eyes. When his feet left the floor, he grabbed onto the two huge fingers just below his chest. They stepped to the grass, and Aranead set Pascual down.

"Welcome to our city, our country. My name is Laura Stewart, President of the United States of America. How should I address you?"

"You may call me Aranead, diplomat of the Cheorka."

Pascual remained standing as Aranead explained the offer and its price to the president. She had many questions. Most interesting to her was that if she refused, Aranead would make his request to leaders of other continents. Finally, she asked for time to consider, and Aranead agreed.

As the screen darkened, Pascual sat down, breathing in the smell of crushed grass. The gathered news crews cautiously stayed shouting distance away. The police were setting up a line in front of them. He could hear their questions, but didn't want to speak right now. Aranead came to stand next to him.

"When you stand so close, I'm reminded you could crush me with one foot." Pascual smiled up at Aranead.

"And I am reminded I would not crush you." Aranead looked around at the throng of reporters and onlookers filling the Mall's grassy expanse. The long steps up to a large, white-domed building in the near distance were filled with people.

"Those devices carried by the people closest to us, they take and transmit sounds and images?"

"Through them, everyone in the world is watching us." Pascual answered, feeling suddenly self-conscious.

Aranead crouched down next to him, bare blue legs standing out next to the black feathers on his haunches. Pascual scooted closer and placed his hand on Aranead's toe. The skin felt soft and pebbly. They sat together, watching the crowd.

Four monks in saffron robes broke out from the line of reporters and crossed the grass toward them.

The oldest monk approached them most closely and spoke. "I am certain that the Dalai Lama would offer his life for this purpose. Please give us time to contact him and make the arrangements."

"The offer will be considered by my clutch. They will make the decision as to whether this person meets our requirements as a leader. I will note that this offer was the first."

The monks bowed. "We will contact him right away." They backed away and disappeared into the crowd. The police line was completed as they passed.

Pascual wondered how long they would have to wait. Would he and Aranead sit here for days, or weeks? He looked around. It was his first time in Washington, D.C., and the buildings'

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scale surprised him. They were huge.

"The steps leading up to the Capitol building, they look like the pyramids my ancestors built."

"They are similar to what I saw in the old pictures."

"If I accept your offer to become an observer, will I be able to see your pictures, the ones you took when you visited so long ago?"

"Of course." Even sitting down, Aranead looked over the crowd. "Is there a terrace at the top of those stairs?"

"I would guess so . . ." Pascual broke off, an electric chill spread through his body as he realized what his friend was thinking about.

"Aranead, diplomat of the Cheorka," the president's voice boomed from the truck-mounted screen, "and my fellow Americans, I have often spoken of sacrifice and counseled you on the sacrifices that we all must make. Today, I am faced with a decision involving the ultimate meaning of the word. Our great country has done more than any other to advance the world toward the future. My sacrifice would follow in that tradition."

Aranead stood to face the screen, and Pascual backed away from him.

The president continued, "However, my advisors recommend I do not make this decision in haste. We must gather more information about the Cheorka and Universal Council before I make any commitment. We urge you, Aranead, to remain in the United States, as our guest, as we deliberate."

A sudden boom caused the crowd to crouch and cringe. Four fighter jets passed close overhead. Aranead watched them as they circled the airspace above his shuttle. He could see the human pilot's helmeted heads in each cockpit as well as he could see the faces of the people gathered on the Capitol steps. It was clear they would restrict him from traveling. He spoke to the crowd of reporters.

"I'm here to deliver my message to all Earth's continents. Our offer is not exclusive to this political entity. A leader from any continent can appoint a member to Earth's observing team upon their own sacrifice. My diplomatic clutch waits in orbit now to verify and audit these sacrifices. You will propose each sacrifice to them and complete it only when the clutch deems it acceptable."

A black-suited man pushed his way out of the crowd of reporters and shouted, "Señor! The president of Venezuela would offer his life for this purpose! As ambassador, I'm delegated to complete whatever application . . ."

He was interrupted by an Asian man, shouting, "The Republic of China will offer a life! It is the largest nation on Earth!"

Aranead faced the president. "The Universal Council offers Earth membership in good will and with good faith. To demonstrate good faith to all Earth humans, I will sacrifice myself here today. I appoint Mr. Pascual Teotalco, my only Earth advisor, to fill one of the seats, if he chooses to accept it. I offer him the honor of conducting my sacrifice. If you will not let the blood, Pascual, I beg you to accompany me as I let it myself."

Aranead turned from the president and went to the shuttle to retrieve the sword. Through the hatch, Pascual saw Aranead step, for just a moment, into the sensorium behind the control console. He was actually going to do it, sacrifice himself here, right now. Pascual jerked his gaze back to the screen. The president's eyes had gone wide, and she spoke off microphone to someone on her right. The crowd continued to shout offers. It sounded like every country on Earth had an ambassador in the crowd.

Aranead jumped down from the hatch and returned to Pascual's side, feathered chest moving in and out rapidly. The giant predator from the stars feared his own death as much as any human would.

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The president spoke, "Please, sir, could I request that an American perform the sacrifice? It would be symbolic for us." Two men dressed in dark suits and sunglasses stepped forward from the rear end of the truck bearing the screen.

Pascual stared at the president in disbelief, then stepped forward, "I am an American, Ms. President, a Mayan American."

Aranead stretched his hand out to Pascual. At the same time he tossed his head toward the crowd, offering Pascual the option of walking away. Pascual saw the chance given. Raising his arms, he rejected it, inviting the huge hand to grab him. Aranead picked him up with one hand and held him to his chest, cradling him with his wing. The sword looked the size of a kitchen knife in his other hand. They walked down the mall, the crowd separating before them, then up the Capitol steps to the terrace. Aranead's toe talons clicked on the white marble as the crowd backed off, leaving them alone.

"I will do this, my friend; there will be no honor lost for you." Aranead lay down on the stone at the top of the stairs and raised the knife. His feathered arm blocked Pascual's view of the crowd filling the mall. Aranead's pupils dilated, as wide and black as Pascual had seen them yet. The raised arm trembled and paused for what seemed like many minutes. Finally, the knife began to fall. Pascual closed his eyes.

The blade clattered on stone.

There was no blood. Aranead's entire body trembled. His arm had fallen across his chest and the knife lay on the marble next to him.

"Rass-qual," Aranead spoke, not through the translator, but in his own voice. His mouth hung open, showing the spiky teeth lining his jaw. Terror jerked Pascual's gut. He grabbed the blade off the ground. It was slightly heavier than the pickax he'd used over the summers he'd worked the groves with Papa.

As Uncle Tomás had taught him, he murmured a prayer to the sacred mountains of Guatemala, asking for the favor in their names. The same moment of fear and hesitation he always felt before cutting a chicken's neck came over him. He had to push past it. He could not say good-bye. Pascual swung the blade over his right shoulder and brought it down hard on Aranead's neck. As his father taught him, he kept momentum and swung twice more, each blow harder than the last, until the blade rang on stone.

The blood coursed over Pascual's arms. Aranead's face twitched. Pascual opened his mouth to say he was sorry, to say it while Aranead could still perhaps hear. Before any words could come out, he realized that Aranead wasn't sorry. He shouldn't be either.

The three Cheorka sat on the floor, their abandoned perches at their backs. They sat on the floor as a courtesy to Pascual. If they'd sat on the perches, their talons would grip the padded bars at eye level. He had to gather his wits. They were diplomats, like Aranead. They weren't going to disembowel him or rip his arms off. He shook his head, suppressing the ancient prey-panic rising within him. They only wanted his attention.

"Will you come to observe at the Universal Council? We are eager to announce the first member of the Earth's delegation." The one named Wa'akon spoke.

Pascual found his voice. "I would like to call home, please, to consult with my family, my clutch." He reached for his phone. His hands were still covered with Aranead's blood.

"Wa'akon, is there a way to clean my hands?"

The three Cheorka looked at each other, their red crest feathers rising up. The one named Deekor said, "You would not lick them clean? It would not

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harm you. It is good blood, very honorable."

Pascual's stomach turned at the thought. It was important that he demonstrate trust in them and respect for their customs. The idea wouldn't have repulsed his ancestors, but they had been gone for a thousand years. The Cheorka stared at him now, their irises noticeably narrowed, crests raised.

"It would not poison," said Wa'akon.

Pascual thought of his first American barbeque. Dr. Colby had invited his new graduate students home for hamburgers. Pascual was walking through the kitchen after dinner when he saw the professor's wife throw away six cooked hamburger patties.

"Mrs. Colby, you couldn't share them with your neighbors?"

"Honey, we hardly know our neighbors!" She'd laughed and continued washing dishes.

He wasn't sure what disturbed him more, wasting good food or not knowing your neighbors. The quality of his respect for the Colbys was changed in that moment, in a way that made it difficult to connect with his advisor.

The Cheorkas' crests lay down as Pascual put one finger in his mouth and cleaned it with his tongue. He tried to think of Mexican blood sausages he'd eaten, but it tasted nothing like that. It was thick and slippery. He gagged on the first swallows, and then licked quickly as he could. If he vomited, it would probably be an insult. As he licked away the last spot of alien blood, he knew himself changed. Maybe now he was an American, like he told the president. But he felt more Mayan, in some ancient sense, than he ever had before. He didn't need to call his parents before he made the decision. He would call them after.

"I didn't have time to ask Aranead; did you understand the message I sent?"

Wa'akon opened her eyes and nodded. "When we last visited, we placed receivers in the debris belt around your sun. All signals in the likely frequency ranges were transmitted to us. In yours, we recognized the number sequence. We'd seen a similar sequence in a message sent earlier. It was the other two components of your message that prompted us to come again. The diamond pattern caught our attention first. The approximate count of Earth days since our last visit, given in the base-twenty system that we use, convinced us."

Wa'akon ran her talon along Deekor's neck, tracing the chain of diamonds outlined there. Pascual felt the air, stirred by the long feathers on Wa'akon's forearm, brush his face.

The Cheork named Chika spoke, "In your message, we saw that you remembered us. After more than five thousand years, you remembered. It indicates a mature and cohesive civilization."

"Why did you choose 5,129 years? How did you know we'd be ready?"

The Cheorka exchanged looks. "We did not choose it. The number has no significance to us."

The statement resonated through out Pascual's body. The skills brought by the aliens so long ago had only been a start. They were tools his ancestors used to create a body of knowledge, calendars, and a method of prophecy that held their own truths.

"I accept the seat on the observing team, to honor Aranead's sacrifice. But before I go, I need to . . ." His voice cracked. How would he tell Mama? Could he stand to look Papa in eye and say good-bye? They might never see Guatemala together now. He wondered if they realized how far he'd strayed from home over these last few years. Now they would know. He couldn't imagine how observing at the Universal Council would change him, but he knew he would no longer be a Mayan or an American. He would simply be from Earth. There was some joy in that, but a full measure of sadness, too. ■

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Anything Would Be Worth It

Lesley L. Smith

The most unlikely things can have practical applications, under the right conditions. . . .

I made it through one more morning without any crying or "crazy incidents." In the coffee shop's early afternoon lull, while I was hanging out reading online high-energy physics articles, there was a commotion in the doorway, with a lot of laughing. I heard shushing, and then someone approached my table.

I looked up and there stood a woman and two beautiful little girls. My heart caved in as I took in their giggly faces.

"Abigail?" The woman's smile was luminous in her round, dark face. "I heard you're a grad student and you do physics tutoring?"

I'd been kicked out, but that was the least of my worries.

The woman continued, "I'm Sophia, a new grad student."

"Yeah, I'm Abigail and I do tutoring," I said, glancing at the girls who were fighting over where to sit. They appeared to be about seven and nine and were dressed in similar all-pink and all-purple outfits, complete with matching barrettes at the end of their frizzy black pigtails.

A little younger, my daughters had also been in their "girly" phases. Against my will, my thoughts were drawn back to last fall.

"Mommy!" my youngest, Emma screamed from the family room.

"Mommy!" Isabella echoed.

I dropped the dinner preparations in the kitchen and ran to the family room. When I got there, the girls were fighting over costumes and my husband, Jacob, was just sitting on the couch grinning, watching them.

I put my hands on my hips. "Please no screaming in the house, girls. What's going on in here?"

Emma's cheeks were flushed and her fine blond hair stuck out every which way. "Isabella tried to take my silver fairy wings! They're mine! Tell her, Mommy."

Isabella's blue eyes flashed as she

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shook her head vigorously, throwing her long hair back and forth. "I need the silver wings. The gold ones don't go!" She pointed at her sparkly pink tutu on the floor.

I turned to Jacob, still leaning back on the sofa, sporting his grin. "A little help here?"

He glanced up at me with mischievous green eyes and a full-fledged smile spread across his face. "Oh, c'mon. They're so cute! Look at them."

I couldn't help smiling back at him. "Agreed—they're adorable. But if someone doesn't finish dinner, we won't be able to eat. And you're on fairy patrol, Jacob, so deal, dude."

He sighed in mock consternation. "Oh, all right." He slipped off the couch onto the floor next to the girls. "The punishment for fairies acting up is the tickle monster!" He grabbed the girls and started tickling them.

They laughed uncontrollably, but didn't try to get away, I noticed.

I took a step back toward the kitchen.

"Watch out for the tickle monster, Mommy!" Emma cried out, reaching for my hand.

Jacob crawled toward me. "Yep, look out, Mommy." He pulled me down on the carpet and three sets of hands started tickling me. I laughed so hard it was hard to breathe.

"Abigail?" a woman said.

Suddenly aware of my surroundings again, I still found it hard to breathe, albeit for the opposite reason. Remembered joy had turned to ashes. My eyes tried to fill with tears, but I blinked them away. No more crying. Last time I'd started crying, I couldn't stop and I'd ended up in the hospital for three months.

Sophia looked from me to her daughters and back again. "Oh dear. I hope it's okay that I brought the girls? I didn't think—"

I forced a smile. "It's fine, of course."

"I'm so sorry for your loss—your entire family—I can't imagine. Do you want to talk about it?" she asked. "Didn't it happen about a year ago?"

One year ago, today. But I shook my head. "It happened a year ago, but no, I don't want to talk about it."

"It'll get better," she said. "Just take it one day at a time."

She had no idea what she was talking about—thank God. It was more like one nanosecond at a time. I cleared my throat. "So you've run into some trouble? You need a tutor?"

The girls had decided on one big chair and were both sitting in it, poking each other.

"Kayla! Brianna!" Sophia said, her good temper beginning to crack. "Girls, please behave."

The older girl got up and whispered something to her mom.

Sophia said, "Okay, girls. You can explore the coffee shop, but please be quiet while Mommy talks to this nice lady."

They were off in a flash toward the window that looked over the university across the street.

Sophia turned back to me. "What were you saying?"

I was not going to obsess about little girls. I turned my palms up.

"What can I help you with?"

She frowned. "It's just that grad school is so much more difficult than I was expecting. I feel like I'm not prepared, especially for quantum mechanics. There are these weird interpretations, like the Transactional one with waves that go forward and backward in time?"

"Yeah." I nodded. "You're thinking of the handshake between the retarded and advanced waves. They're supposed to cancel one another out. You're in luck; quantum mechanics was my specialty—"

A strange rocking noise came from the corner of the room by the window. I glanced over and saw the younger girl had climbed up the huge wooden shelf and it was starting to topple over onto the other girl.

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Sophia cried, "Oh my God!"

We both jumped up.

This cannot happen again! The next thing I knew, I was standing next to the shelf holding it up against the wall as merchandise showered down on me.

They kid working behind the counter yelled, "Hey! You break it, you buy it!" but made no move to come over and help us.

While ducking down, I thought I saw a woman who looked like me sitting at my table, but when I looked back she was gone.

"How? What?" Sophia asked. Then she rushed over to us and grabbed her daughter off the shelf and hugged her.

I managed to set the shelf upright.

"Kayla, what were you doing? You should know better than to climb furniture!" Sophia bent down and hugged both her daughters at the same time. "I would just die if anything happened to you two."

Sadly, that probably wasn't true.

After a few more moments of hugging, Sophia let go of her daughters and stood up. She looked at me. "I don't understand what just happened. But thank you from the bottom of my heart." There was that luminous smile again. "You just appeared next to the shelf. It was like magic."

My mouth fell open. "Wait. You saw me do something like magic?"

Could it be my doctors were wrong and I wasn't crazy? A tiny seed of hope sprouted in my chest. "I'm not sure what happened. I just knew I couldn't let the girls get hurt. Can you tell me what you saw?"

"I didn't really see anything," she said. "I was looking at my daughters." She shrugged. "I thought you were sitting over there, and then you materialized out of thin air in front of the shelf."

I nodded even though I didn't quite understand. There was something important here though.

"I hate to think what would have happened. . . ." she said.

"Me too," I said.

"Oh dear, Abigail, you're bleeding!" Sophia said.

I reached my hand up to my head. It was wet, and when I held my hand out it was red with blood. Weird.

"You have to let me take you to the emergency room," she said. "It's the least I can do—you might need stitches. I'm parked right outside." She took me by the arm and led me out the door.

Outside on the curb I had an unfortunate epiphany as she directed me to her nondescript dark SUV. She expected me to ride in her car! I hadn't ridden in a car for almost a year—not since the accident that claimed my family. There was *no* way I was getting in that car. I stopped abruptly on the sidewalk. "No. Thank you, but no, I'm not going with you."

"What?" Sophia asked. "You have to go to the hospital."

My heart was racing. "No. You don't understand. I was in a crash with my family. I can't ride in a car!"

"Well, I can't let you bleed to death," she said. "Should I call an ambulance?"

"No!" Unwillingly, my mind went back to Emma's fine hair matted to her little head with blood, to Isabella's dulled unmoving eyes, and the bubble of blood that came out of Jacob's mouth when he tried to speak, right before he never tried to do anything again.

Suddenly the pieces fell into place. I just went back in time to save Sophia's girls, so I should be able to save *my* girls! I concentrated with all my might on waves that went back in time, and then I felt a Herculean wrench.

I was standing on a front stoop, my old front stoop, and I felt very woozy. Maybe an ambulance wasn't such a bad idea. Shaking, I lifted my finger to the doorbell and pressed the button.

As I heard footsteps approach in the front hallway, I had to grab the front planter to keep from keeling over.

The door opened and I found myself face to face with . . . me.

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Apparently dazed, other-me reached out and took my hand.

And then I did fall over.

The next thing I knew, I was lying on my old family room couch.

I appeared to be leaning over myself, peering into my face. "Are you me?" the other me asked.

"Yes." There was something important I was forgetting. "Wait! What day is it?" I yelled.

"Tuesday, October 31," she said, crouching down. "You're in bad shape. Can I take you to the hospital?"

"The year! What year is it?"

"2006," she said and paused. "Time travel?"

"Yes. I have to warn you."

"Warn me?" She leaned back, her eyes straying to a family portrait. She gulped. "Who do I, er, we lose?" she asked, her voice husky.

I forced back tears as I looked at her, unable to speak.

She looked at me, then at the picture, and then back at me. "All of them?" she whispered.

I nodded, tears escaping.

"Oh my God," she whispered, tears running down her cheeks. "How? What happened?"

"Car accident. Jacob driving." I tried to wipe my face, but my hand was shaking too much. "Tonight."

"Tonight? Oh, my God."

I felt so dizzy I almost couldn't get the words out, "On the way to the trick-or-treat party." I was starting to feel something was seriously wrong with me.

She leaned over the couch and clutched me to her. "Oh my God. Thank you. Thank you. Thank you."

When she finally released me, I said, "I don't feel so good."

"You do look ba—uh, you could look better. I'm calling 911."

As she called an ambulance, I struggled to stay conscious.

"They'll be here in a couple minutes. Hang in there." She grabbed my hand. "Uh, how did you get back here?" Her face brightened. "Did you build a time machine?"

"No. Transactional interpretation," I whispered. "I guess the waves didn't cancel out."

Other-me looked off into the distance. "The advanced waves that travel into the past and the retarded waves that travel into the future don't always cancel out?" She peered at me. "But that would violate causality."

I tried to nod. "Yes. You're good, stay in school—" I could hear the sirens approaching, but they were fading.

"Abigail? " she asked. "Come on, stay with me!"

"If you keep them safe, it was worth—"

She was gone. I could tell because the haunted look left her eyes, and my soul shuddered.

There was pounding on the front door.

I went over to open it. "She's over here." I led the EMTs into the family room.

They ran over to her and knelt down. One of them said, "Twin sister?"

I nodded as the tears started cascading down my cheeks again.

"I'm very sorry, miss. She's gone."

I sank down in a chair, cradling my head in my hands. Oh my God.

"Abigail!" Jacob yelled, running into the room. "Why's there an ambulance here? Abigail! Answer me! Are you okay?" He must have seen the figure on the couch because then he screamed, "No!"

I jumped to my feet. "Jacob! I'm here. I'm okay. "

He ran over to me and crushed me in his arms. "Thank God," he said into my hair. We clutched each other as if our lives depended on it.

"What's happening, Mommy?" Isabella asked from the front hallway.

Jacob and I let go of one another, and I ran into the hallway and hugged them. "Girls, please don't go into the family

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room." I turned back toward Jacob. "Can you please take them into the kitchen?"

"But we have to get ready for the party, Mommy," Emma said.

"I'm sorry, girls. We can't go to the party," I said.

"Aw! I wanna be a fairy!" Emma stomped her feet.

"That's not fair!" Isabella said, throwing her long hair back and forth. "I wanna wear my costume!"

Jacob came and took them by the hands. "What the hell is going on? Do you have a twin sister?" he whispered to me.

"I'll tell you later," I whispered back. "Girls, you can put on your costumes. We're going to have our own party at home tonight."

I watched my very confused husband lead our grumpy daughters into the kitchen and another tear escaped.

It was worth it. Anything would be worth it. ■

It is no use saying, "We are doing our best." You have got to succeed in doing what is necessary.

—Winston Churchill

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THE EXPERIMENTAL EVIDENCE AGAINST OBJECTIVE REALITY

Quantum ***entanglement***, a phrase first coined by Erwin Schrödinger in 1935, describes a condition of the separated parts of the same quantum system in which each of the parts can only be described by referencing the state of other part. This is one of the most counterintuitive aspects of quantum mechanics, because classically one would expect system parts out of speed-of-light contact to be completely independent. Thus, entanglement represents a kind of quantum "connectedness" in which measurements on one isolated part of an entangled quantum system have non-classical consequences for the outcome of measurements performed on the other (possibly very distant) part of the same system. This quantum connectedness that enforces the measurement correlation and state matching in entangled quantum systems has come to be called ***quantum nonlocality***.

Nonlocality was first highlighted by Albert Einstein and his coworkers Boris Podolsky and Nathan Rosen in their famous 1935 EPR paper. They argued that the nonlocal connectedness of quantum systems requires a faster-than-light connection that appears to be in conflict with special relativity. This criticism of quantum mechanics was ignored by most of the physics community until 1964, when John S. Bell, a theoretical physicist working at the CERN laboratory in Geneva, used the formalism of quantum mechanics to show that certain experimental tests could distinguish the predictions of quantum mechanics from those of alternative theories that were "local," in the sense that nonlocality was eliminated. Bell based his calculations not on measurements of position and momentum, the focus of Einstein's arguments, but on measurements of the states of ***polarization*** of photons of light.

In a propagating light wave, if the electric field oscillates in the vertical or horizontal direction the light is said to be linearly polarized vertically or horizontally. If the electric vector corkscrews through space in a counterclockwise or clockwise direction, as viewed from the front, the light is said to be right or left circularly polarized. A mixture of linear and circular polarization is called elliptical polarization. As an example, my sunglasses pass light that has vertical linear polarization and block light that has horizontal linear polarization because the latter is produced by reflection and glare.

Bell showed, essentially, that when pairs of polarization-entangled photons are measured for linear polarization in particular directions, quantum mechanics predicts that the coincidence rates between detections of the entangled pair vs. the angle between the polarization measurements can be used to generate a quantity that has a value of 2.8 according to quantum mechanics, while "realistic local" theories predict that the same quantity of 2.0 must be less than.

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This difference occurs because the coincidence rate predicted by quantum mechanics (and the classical Malus Law of polarization) falls off as the ***square*** of angle between the measured linear-polarization directions, while all local theories predict a ***linear*** falloff. The mathematical expression of this dichotomy is called ***Bell's Inequalities*** or ***Bell's Theorem***.

Since the 1970s, experimentalists have performed many "EPR experiments" based on Bell's Theorem. (See my AV Column, "Einstein's Spooks and Bell's Theorem," *Analog*, January 1990.) These experiments have consistently found with high statistical precision that Bell's quantity has a value of 2.8, demonstrating the validity of the nonlocal predictions of quantum mechanics and falsifying alternative theories that are local and "realistic" (see below).

But do such EPR experiments actually demonstrate the existence of quantum nonlocality? As it turns out, there is more than one way of interpreting the implications of the EPR experimental results, and there is a dispute as to whether it is locality or "realism" (the objective observer-independent reality of external events) that has been refuted by the EPR measurements. To put it another way, to accommodate the results of the EPR experiments, either one has to accept that there is some mysterious "nonlocal influence" that acts across space-time to force the results of separated measurements to be consistent with each other and with conservation laws, or one has to relinquish the concept of objective reality, the idea that the universe exists with well-defined properties, independent of what we choose to observe and measure. Local realistic theories have been falsified by the EPR experiments based on Bell's Theorem, but is it ***locality*** or ***realism*** (or both) that has been eliminated?

The reaction of the general physics community to these Bell's Inequality test results has been either (a) to ignore them altogether (as the majority of working physicists seem consistently to do) or (b) to assume objective reality is okay and to admit grudgingly that nonlocality is perhaps an inseparable aspect of quantum mechanics.

However, Noble Laureate Tony Leggett of the University of Illinois has recently pushed this issue somewhat farther. He has demonstrated that by focusing on the falloff of correlations with ***elliptical*** polarization rather than the linear polarization of the Bell Inequality EPR experiments, one can compare the predictions of quantum mechanics with a class of nonlocal realistic theories. The resulting Leggett Inequalities can be used in the same way as the Bell Inequalities, but to test ***nonlocal realism*** instead of local realism.

A group of experimentalists at the Institute for Quantum Optics and Quantum Information (IQOQI) in Vienna has now performed an EPR experiment that is a definitive test of the Leggett Inequalities, and their results have recently been published in the British science journal ***Nature***. They show that in EPR measurements with elliptically polarized entangled photons, the Leggett Inequalities in two observables are violated by 3.6 and by 9 standard deviations. This in interpreted as a statistically significant falsification of the whole class of nonlocal realistic theories studied by Leggett.

The group summarizes the implications of their results with the statement, "We believe that our results lend strong support to the view that any future extension of quantum theory that is in agreement with experiments ***must abandon certain features of realistic descriptions***." In other words, quantum mechanics and reality appear to be incompatible.

Is the case against objective reality truly so strong? To answer this question, we must examine in more detail the nonlocal realistic theories that Leggett

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studied. This class of theories assumes that when entangled photons emerge from their emission source, they are in a definite state of polarization. It is well know that when that assumption (and no others) is made, one does not observe the quantum mechanical prediction of Malus's Law for the correlations of the photon pair.

However, Leggett cures that problem by assuming an unspecified nonlocal connection mechanism between the detection systems that fixes the discrepancy. In effect, the two measurements talk to each other nonlocally in such a way that the detected linearly polarized photons obey Malus' Law and produce the same linear polarization correlations predicted by quantum mechanics calculations. Leggett then shows that this nonlocal "fix" cannot be extended into the realm of elliptical polarization, and that quantum mechanics and this type of nonlocal realistic theories give differing predictions for the elliptic polarization correlations. In other words, the "reality" that is being tested is whether the photon source is initially emitting the entangled photons in a definite state of polarization. It is this version of reality that has been falsified by the IQOQI measurements.

We can clarify what is going on in these experimental tests by applying the Transactional Interpretation (TI) of quantum mechanics (See my column, "The Quantum Handshake," in *Analog*, November 1986) to these Leggett Inequality tests. As some of you readers may know, I originated the TI in 1986, and it is considered to be one of the leading alternatives to the orthodox Copenhagen Interpretation of quantum mechanics.

From the point of view of the TI, Leggett's assumption that the entangled photons are emitted in definite states of polarization is wrong. The "offer wave" for each photon that emerges from the source includes all possible polarization states. These offer waves travel to downstream detectors, and time-reversed "confirmation waves" travel back up the time-stream to the source, arriving at the instant of emission. A three-way transaction then forms between the source and the two detections that matches the confirmation waves to a mutually consistent overall state that satisfies appropriate conservation laws (in this case, conservation of angular momentum). The final result is a completed transaction with the two photons in definite states, but this definite state was not present in the initial emission of the offer waves, and that is the part of the process described in detail by the wave-mechanics formalism of quantum mechanics. We note that the TI does not in itself make any predictions about the linear or elliptical polarization correlations of the entangled photon pair. It only describes the quantum formalism that is making the predictions that the IQOQI group has observed to be consistent with their experiment, but it clarifies what is going on in those predictions.

Does this mean that the TI (and the quantum formalism it describes) are not "realistic," i.e. inconsistent with an objective reality that is independent of the observer's choice of measurements? I don't think so. The transactions that form in quantum processes arise from a "handshake" between the past and future across space-time, but they are not specifically the result of measurements or observer choices. The latter are only a small subset of the transactions that form as the universe evolves in space-time. The message of the Leggett Inequality tests, from the point of view of the TI, is that the assumption of emission in a definite polarization state is too restrictive. I would argue that initial emission without a definite polarization state is not inconsistent with objective reality and is consistent with the quantum formalism.

The TI description of the quantum formalism is realistic and nonlocal, in at

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least some definitions of those terms, and it is completely consistent with the IQOQI results. To put it another way, Leggett has set up a straw man that has been demolished by the IQOQI tests, but that is only an indication that his version of "realism" is too naïve. And this theory and experiment can be viewed as another demonstration of the value and power of the TI in understanding the peculiar predictions and intrinsic weirdness of quantum mechanics.

Since this is an SF magazine, we should as usual consider the science-fictional implications of this work. Ignoring my remarks above about the TI, these experimental results could be viewed as reinforcement for the "observer-created quantum reality" (i.e., non-realism) that is an important theme in contemporary SF. This theme goes back at least as far as Greg Bear's pivotal novella ***Blood Music***, a story that concludes with the formation of a planet-wide group mind, an entity that acts as the proverbial 1,000-pound gorilla and can collapse wave functions any way it damn well pleases. Perhaps the "ansible" used by LeGuin, Card, and others might be considered a SF use of nonlocality. With that exception, there has not been much SF written that uses the weirdness of quantum nonlocality in a central way (although I may write some of that soon). The IQOQI tests could be viewed as calling quantum nonlocality into question, but I would argue against that view using the transactional analysis of the IQOQI experiment described above. But, as usual, SF authors are free to work all sides of the street, when it comes to quantum phenomena, and we readers reap the benefits of that diversity.

AV Columns Online: Electronic reprints of about 140 "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available online at: <http://www.npl.washington.edu/av>

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A City Forged of Steel

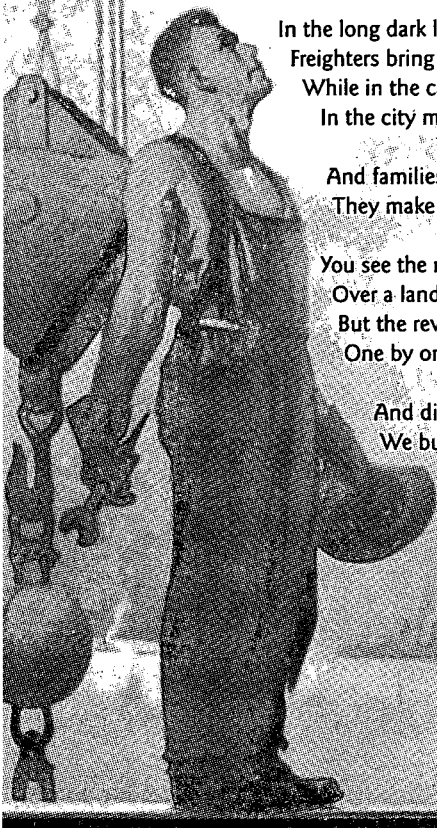
By Geoffrey A. Landis

On the far edge of the lunar sphere they built strong domes of steel
A city of nickel-iron and platinum ore
A city built by immigrants, this city forged from steel
A city made of dreams from steel forged.

They left the earth for Luna, built this city to call home
This city they call Luna is their home.

The union men in hard hats stamp the steel from the forge
Iron men pour white-hot metal by the ton
Mass-drivers fling the ingots out; ion freighters bring in ore
The sparks of electric welding bright as sun.

And immigrants and union men came to make Luna home
They built a Lunar city to call home.



In the long dark lunar nighttime, ion rockets cross the sky
Freighters bring asteroid ore to Luna Field
While in the caverns far below the children learn to fly
In the city made of dreams and hot-rolled steel.

And families and children built this city to call home
They make this lunar city that's our home.

You see the round and sassy Earth from the cemetery on the hill,
Over a landscape gray with hills and piles of slag
But the reverberating furnaces that once turned ore into steel
One by one are shutting down their trade.

And dissidents and exiles build this city we call home
We built this city Luna we call home.

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And dissidents and exiles build this city we call home
We built this city Luna we call home.

The age of Earth is ending, the moon's shipyards slack their pace
The mills that built the colonies shutting down
Freighters still crawl orbital lanes, leviathans of space
But colonists now head for Jupiter and beyond.

And you and I together built this city that's our home
We built this Lunar city and called it home.

The lunar mills are closing, but the city they built remains
A working town, still working, hard annealed
And planning a new future, of new and better dreams
Forging new plans as hard and hot as steel.

Plans to move on outward, we will build new ships of steel
New ships of steel to head into the dark
On fusion flames we'll leave the outer planets in our contrail
Our ships of steel will head out for the stars.

And immigrants and dissidents will build starships of our own
And leave behind this city that is our home.

We'll launch out from the lunar sphere in new ships forged of steel
With habitats of rock and rebreathed air
New cities, built by dissidents, new cities forged from steel
Our homes are made from dreams and iron ore.

And all of us together will build this starship on our own
And bring with us this city that's our home.

—for the steelworkers of Cleveland

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Salvation

Jerry Oltion

Might there be more than one way?

The scientist was sweating. The conference room of the Universal Church of the Divine Revelation was air-conditioned against the muggy Florida heat, but no amount of cool air would comfort the supplicant seated before the board of regents. That suited the Reverend Billy Dickerson just fine. Scientists ought to sweat in the presence of clergy, just as they would sweat in the afterlife to atone for the multitude of sins they had committed against the Church over the past two millennia. Especially scientists like this William Winters, the type of snooty academic who would no more call himself "Billy" than he would get down on his knees to pray to the Lord. His kind were all equations and electrons and tensors and theories—theories presented as if they were facts, when everybody knew that the very word "theory" meant that it was just some egghead's crazy attempt to remove God from the explanation.

Oh yes, let this scientist, this precious William, with his refined mannerisms and his ridiculous ideas, sweat. Let him loosen his tie and wipe his palms on his polyester pants while he tried to impress the regents with his credentials. Let him squirm, because the words he spouted were insults to the Savior and to the men of faith who preached His word.

"You're used to buying scientists," William was saying. "People who will rubber-stamp your preconceived notions of the way things work. All that does is call your own integrity into question. It's time you bought some actual science for a change."

That bought him a ripple of indignant frowns from the other six regents seated at the conference table, but Billy couldn't resist a smile. He had to admire the man's nerve, if nothing else. This blasphemer had walked into the lion's den on his own initiative, knowing the reception he would get, but he wasn't mincing words in an attempt to curry favor. He was sticking up for his principles, however

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misguided they might be.

"You're no doubt referring to our recent work on intelligent design," Billy replied. "You may think what you like, but all our researchers are given complete autonomy in their investigations."

"After you hand-pick them for their adherence to the paradigm you support," said William. "I'm talking about looking at the facts and accepting what those facts tell you about the way the universe works."

"And these supposed 'facts' would be what? Newtonian physics? But no, that was later proven wrong by Einstein. Lamarckian inheritance? No, that was disproven by Mendel and his peas. Evolution? Where are the intermediate forms?"

"Probably in your lungs," said William.

That caught Billy off guard. "What?"

"There are intermediate forms of viruses and bacteria all around us. They're constantly evolving. Why do you think you need a new flu shot every year?"

"I don't get flu shots," said Billy. "Vaccination is an evil plot to destroy the minds of our children through mercury poisoning."

"Ah, yes, of course," said William. "You've caught the A.M.A. red handed. How remarkable. But we were talking about your belief that there were no intermediate forms to prove the validity of evolution. So if you were to catch tuberculosis, may I assume that you would ask your doctor to treat it as if the bacillus hadn't evolved?"

Billy hesitated. That was a trick question. It was like asking a man if he had stopped beating his wife; there was no good answer to it. He considered how he should respond, but Roland Matson was already stepping in to cover his back.

"You didn't come here to lecture us on evolution," Roland said in the thin, reedy voice that had kept him from developing his own television ministry. "You've asked us to buy science rather than scientists. Why don't you explain that statement instead? What kind of science would you have us purchase?"

"Physics," said William. "Specifically M-theory, which posits ten spatial dimensions and one time dimension, any of which are accessible with the proper equipment. I'm asking you to fund the construction of that equipment."

Billy found his voice again. "What for?"

"To save humanity." William let that statement hang for a second before he went on. "The energy level in these extra dimensions is wildly different from the three that we see. And any time you have an energy gradient, you can generate power from it. In this case, enough power to fuel all of human society a million times over, without pollution and without strife."

"An admirable goal," said Billy, "if it were to succeed. But the fact that you're coming to us instead of the federal government tells me that your chances of success are slim. What makes you think that we would be interested in funding this when the Department of Energy would not?"

"The Department of Energy won't touch it because the people who run it—that is to say, Congress—have a considerable investment in the status quo," said William. "And you will because the same equipment that opens up the spatial dimensions can be used to open the temporal dimension," said William.

None of the regents, including Billy, wanted to touch that statement.

"I'm talking time travel," William went on. "You could go back in time and meet Jesus. Assuming he existed."

Billy remembered that day in the boardroom with the clarity of a car wreck. The pandemonium that erupted after the physicist's statement was a thing to behold. Three of the regents had begun shouting at once, accusing him of blasphemy, chicanery, and outright flimflammery, while two more rose from their chairs and stalked out of the room. Old Roland had giggled like a schoolgirl. And Billy had watched the scientist

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clench his jaw and glower like a man who had played his last card and lost, but who had expected every one of those reactions from such Philistines as these.

He couldn't say why he invited William into his private office and poured him a two-finger glass of his finest bourbon. Perhaps it was God directing his will, or perhaps it was simple curiosity, or maybe even a touch of admiration for this misguided sinner who nonetheless believed what he believed with an intensity that rivaled Billy's own faith in the Lord. Whatever the reason, the two of them were soon talking like old fraternity buddies, and William was telling Billy how his theories predicted time travel as an almost inevitable consequence of dimensional transfer.

"Why did you come to us with this?" Billy asked him. "You don't really believe that we could go back in time to meet Jesus, do you? You don't even believe in Jesus."

William swirled the last of his bourbon around the bottom of his glass. "I believe there was probably a man named Jesus. Perhaps a very remarkable man. But I believe he was just a man. And frankly, I would like the chance to prove it to one of you true believers. Maybe if you saw what he really was, you'd put your effort into reality instead of promoting a fantasy."

"Reality," Billy snorted. "Like time travel."

"Like time travel," said William.

The man would have made an excellent televangelist. He believed what he was saying with such intensity that he nearly made Billy believe it, too, but that didn't happen until the sheet of paper appeared in the air about a foot above Billy's desk and fluttered down to drape itself over the telephone.

The two men regarded each other like witnesses to a UFO abduction, then while the scientist checked his watch, Billy slowly reached out and grasped the paper. It was his own letterhead. Written on it in his own angular, precise handwriting were the words, "It works. Give him the money. You almost named the dog Solomon."

The hair stood up on the back of his neck. Paper appearing out of nowhere was a good trick, but it might easily be just that: a trick. Duplicating his letterhead and his handwriting wouldn't be all that difficult either. Knowing the name that Billy had considered but rejected for his German shepherd fifteen years ago was a different level of feat entirely.

"May I see that?" William asked. Billy handed the paper to him, and when the scientist read the words scribbled on it, his mouth bent upward in a grin that his face clearly wasn't accustomed to hosting. "Well, I'll be damned," he said softly.

"Yes, probably so," said Billy. "And so may I. But it seems we may find ourselves doing business after all."

The board of regents wouldn't be swayed, so Billy split his ministry away from the others and funded the project on his own. He became a regular visitor to William's lab, at first to watch where his money was being spent, then later out of genuine interest in the science behind it. If William was deluded, his was one of the most self-consistent delusions Billy had ever seen. And as his equipment slowly grew in sophistication, his theory became closer and closer to practice, until the day when William's wristwatch appeared in the transmission chamber that he had just that morning declared ready for a test.

"One of the things I love about time travel," William said, picking the watch off the chamber's wire mesh floor, "is the instant gratification." He compared the watch with the one he wore on his wrist. They looked identical except for the time. The new one read an hour and ten minutes fast.

"No pressure," Billy said, chuckling softly.

William laughed with him. "Right. Let's get this show on the road."

It actually took less than an hour to set

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up the jump. They still had fifteen minutes left before William's original watch would read the correct time, and they were having a hard time waiting. William said, "I'm tempted to do it now and see what happens. Will the universe let us create a paradox?"

"Why don't we see?" asked Billy.

They looked at each other like children who had dared each other to jump off the end of a pier. "There are a million good reasons why not," William said. "And one very good reason to do it," he added, setting the watch in the cage.

"Science," said Billy.

"Exactly. We already know time travel works. Let's do the next experiment."

William hit the switch. The watch disappeared. For a moment, that seemed to be the end of it, then there was a feeling of disorientation, as if they were in an elevator car that had begun to rise and descend simultaneously.

"What was that?" Billy said.

"If I had to guess," William replied, "I would say that was the universe rearranging itself to fit the new reality." He looked at his wristwatch, then at the digital clock on his workbench. They read the same time. "It adjusted," he said. "Do you remember the paradox?"

"Gugenfrienchen?" asked Billy. "Wakari misu?"

"What?"

Billy burst out laughing. "Gotcha! You should see your face."

William slowly grinned. "All right, smart ass. Now let's do the next jump straight."

It took them most of the evening to haul the equipment to Billy's office, but they got it set up by nine and the jump calculated not long after. "It was three-twelve," said William. "I checked. Do you remember what you wrote?"

"I don't need to." Billy took the paper out of his desk. "Should we send the original, or should I write another?"

"Write a new one," said William. "If we send the original, we put it in a closed loop and never get it back. We don't want to lose the first object to travel in time. We'll want that for the Smithsonian someday."

"Oh. Yes, I suppose you're right." Billy took out a fresh sheet of letterhead and wrote on it: "It works. Give him the money. You almost named the dog Solomon." Then he slipped the paper into the cage, the wire mesh floor of which stood about a foot above the surface of his desk, right where the phone was before they had moved it to make room.

William watched the countdown clock on the computer screen. When it hit zero, he pushed the "go" button. The paper vanished.

"Now we build one big enough for people," he said.

That was the work of another year, a year that Billy spent learning Aramaic and brushing up on his Latin. He flew to Israel several times to scout out the territory, eventually renting a ground floor flat in a new settlement on the outskirts of Jerusalem. Two thousand years ago the area where it stood would be far out in the wilderness, at least half a day's walk from the ancient city. The time travelers should be able to arrive there without attracting attention, and more importantly they could store their return equipment there without it being discovered and stolen by passersby.

Of course it was anybody's guess whether the flat would still be standing when they arrived from America with the time machine. The Palestinians were still lobbing rockets into the settlements every few days and the Iranians were threatening to do the same. It was business as usual in the Middle East, but Billy didn't know how they could go on like this, nursing hatred for generation after generation in the holiest of lands.

Perhaps he would ask Jesus if He could do something about it.

At last William declared the human-sized time machine ready. They tested it with short jumps in his own lab, and they tested the portable return unit that

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they would carry with them, and it all worked as he had designed it. So they boxed it all up and took it to Israel.

When they got there, they bought desert clothing and survival gear that they hoped would pass for authentic two millennia earlier, keeping it as plain and simple as possible. They carried gold and jewels to buy whatever else they needed once they made their jump.

Within a surprisingly short time, they were ready to go. Billy had already calculated the best time to find Jesus in Jerusalem, settling on the last year of his ministry. William keyed it into the control computer and sent the return machine to those coordinates, then he set the destination time back ten minutes and motioned Billy into the transfer cage.

"This is the moment of supreme faith," Billy said as he stepped in and pulled the wire door closed. "Ironic, isn't it, that I'm placing my faith in science?"

William shrugged. "No more ironic than our first major trip being a visit to a religious fanatic. Ready?"

"As ready as I'll ever be." Billy saw William reach for the "go" button, and then his ears popped and bright sunlight stabbed his eyes and he dropped about six inches onto dry sand.

"Welcome to the past," William said from off to his left.

Billy blinked and squinted until his eyes adapted to the light. He knew that William had planned to set the coordinates for his own jump to arrive a few minutes before Billy, but it was still disorienting to find him already there.

They had arrived in a rocky wilderness filled with scrub brush and the occasional twisted, stunted tree. The city was just visible several miles in the distance, and a camel caravan was winding its way around a hill to the east, but there was nobody anywhere close to their landing site. Billy noted that William had already cleared the rocks away from the spot where he stood.

"I almost turned an ankle on one," William explained when he realized what Billy was looking at.

Billy took a deep breath of the air. He had expected it to smell better than twenty-first-century Israel's air, but there was a smoky tang to it that spoke of many, many wood and dung fires burning for many, many years in this land.

"Well," he said. "Here we are."

They spent the next few minutes preparing a place to hide the return machine. When it arrived, they carried it over to the hollow they had dug beneath a cedar tree and buried it there, wrapped in plastic to keep the sand out of the works. Then they set out for Jerusalem, looking back often to fix in their minds the spot where their return ticket waited.

When they arrived in town, their robes drew stares not for their style but for their cleanliness. Apparently, people walking in out of the desert seldom looked like they had just stepped out of a modern flat only a few hours earlier. Billy was apprehensive about that at first, thinking that it was seldom good to stand out among strangers, but the two travelers were immediately greeted as visiting royalty, and when Billy explained in his strangely accented Aramaic that they had come from a far, far land to visit Jesus, they all nodded knowingly.

"His influence spreads like the wind," said one of the men in the crowd. "Come. I can take you to him."

They set off through town, dragging a train of curious onlookers behind them. Their guide kept up a constant barrage of questions about their homeland and their travels, eager for news of the world beyond his own, and Billy was hard pressed to portray a consistent story that didn't make them sound like lunatics. His Aramaic was stretched to the limit, and William's was even worse. The physicist had to make do with Latin, which the locals seemed less than pleased to hear.

They found Jesus in an inn, drinking wine with a couple dozen other patrons and playing some kind of game that involved tossing little beanbags about the

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size of golf balls into a mug on a high shelf across the room. He looked nothing like the paintings in Billy's church. He was short and dark skinned and bearded, with dark curly hair that was cut short enough to expose his earlobes, rather than the long, luxurious locks so often depicted in bibles. To Billy's Anglo-Saxon eye, he looked, in fact, like practically every other man in the room, and some of the women.

When he had been pointed out, Billy knelt before him and said haltingly, "Lord, we have come from afar to hear your wisdom and offer you our devotion."

"Lord?" Jesus said, a bit taken aback. "Don't say that in front of the Romans or I'll be in serious trouble."

"My apologies, Lo—my apologies," Billy said. "I have no wish to hasten your martyrdom."

"Me either," Jesus exclaimed, to much laughter. "Come now, this kneeling isn't necessary. Rise and share a cup of wine with us and tell us of your travels."

"We would be honored," said Billy.

It didn't take long to grow comfortable in the savior's presence. The man had charisma, that was certain. He knew how to get people talking about themselves, and he would listen intently, as if they were the most important person in the room. Billy found himself revealing much more than he had intended, stopping only at the news that he and William were from the future.

"You have built churches to spread my teachings?" Jesus asked, incredulous.

"We have," Billy admitted. "I'm the leader of one. That's why I've come here: to learn from you directly."

"And you?" Jesus asked William. "What is your purpose in coming all this way?"

"I came to see if you really existed," said William in Latin.

Far from being offended, Jesus laughed. Also in Latin, he said, "I appreciate your honesty. And what do you think? Do I exist?"

William nodded. "The man, certainly. The son of God? I don't have enough data to make that judgment yet."

"Nor do I," said Jesus.

Billy nearly choked on his wine. "What? What about the loaves and the fishes? What about the sermon on the mount? And you raised Lazarus from the dead!"

Jesus shook his head. "I don't remember raising anyone from the dead. Simon and Andrew and I had a good day with a net during the famine several years ago, and I've preached my share of sermons, but the tales seem to grow in the telling."

"But . . . you . . . I . . ." Billy spluttered, unable to bring himself to argue with Jesus's depiction of his own life, but unable to quite believe what he was hearing, either.

The conversation went on like that for some time, with Jesus showing amusement and occasional irritation at how his reputation was getting out of hand. "I'm tempted to change my message," he said at one point, "just to see if anybody's actually listening anymore."

"You couldn't!" Billy said, aghast.

"I could. There are dozens of ways to improve people's lives. That's all I'm trying to do: help people to see that their existence doesn't have to be all drudgery and despair."

William gave him an appraising look, then said, "You should try science."

"Spoken like a Roman," said Jesus.

"Spoken like a humanist," William replied. "Science packaged with your message of love and compassion could transform the world two thousand years early. We could have an age of reason and an age of enlightenment simultaneously. Humanity could escape the cycle of religious fanaticism that has kept us fighting like cats and dogs for millennia."

Billy could hold his tongue no longer. "Who are you to preach to the Lord of Creation? Still your blaspheming tongue before I still it for you!"

"Ah, yes, threats of violence for espousing rational thought," said William. "I rest my case."

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"Come now," said Jesus. "You surely didn't travel all this way just to continue an old argument. Have more wine and see if you can get one of these in that cup over there." He held up one of the beanbags he had been about to toss when they had arrived.

The party lasted well into the night. Billy was surprised to find himself less sure about Jesus as the night progressed. The man was wise beyond his years, certainly, and he commanded the respect of everyone in the inn, but that's as far as he took it. He downplayed any mention of his divinity, deflecting it into a discussion of the divinity of everyone, and he spoke mostly about practical matters like usury and making sure there was food and housing enough for everyone. At one point he began talking with William about footwear, of all things, asking to see his sandals and pressing him for details on how they were made. William launched into a discussion of how rubber was vulcanized, which morphed into a discussion of science in general, ending with a description of the scientific method of investigation. "That's what you need to incorporate into your message," he said. "Science. Rational thinking."

Jesus took it all in like a sponge, but when William had run down, he said, "You should have gone to Rome rather than here. The Romans already believe as you do."

"Hah," William said. "They worship gods even crazier than yours. No offense."

"None taken," said Jesus, holding up his hand to forestall Billy's almost instinctive response.

"Rome is on the way out anyway," said William.

Jesus expressed his doubt of that with a raised eyebrow.

"It's true. Not in your lifetime, but its influence will pass. Science will die out for nearly two millennia. Believe it or not, Italy will become the center of the religion based on *your* message, not theirs, and it'll get to the point where they'll imprison Galileo for figuring out the motion of the planets. Islam will pick up the slack for a century or two, but it'll eventually turn its back on science as well."

"Clearly my traveling companion has drunk too much wine," Billy interrupted.

"Clearly, what Jesus here needs to do," William powered through, "is combine his message with Rome's from the start. Like I said earlier, if you incorporate science into Christianity rather than exclude it, you could have the best of both worlds. You could start the age of reason two thousand years early, and we could avoid all the wars over whose god is stronger and meaner than everybody else's."

"Science," Jesus said.

"Science," William said.

"It's time to go," Billy said, rising from the table.

Jesus wasn't done, though. He and William talked deep into the night, long after the others had drifted off to bed. Billy stayed to defend the faith, but it was clear that Jesus was more interested in William's practical advice and knowledge than in Billy's memory of scripture and dogma. Billy found himself on the fringes of the conversation, tolerated but no longer included, and he even drifted off at one point, only to wake with a start when he heard Jesus say, "Yes, this scientific method sounds very much like something I've been thinking all along, but couldn't put into words. Investigate, *then* explain. It makes so much more sense that way."

At last, when the sun began peeking through the windows, Jesus finally yawned and said, "Well, this has been fascinating, but I've got a temple to raid today, and you two need some sleep. Will I see you again?"

"Probably not," Billy said quickly. "We were just passing through."

"Well, then," said Jesus, "I'm glad we met when we did. I wish you well in

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your travels." With that he got up and tottered off into the back of the inn.

Billy was in no better shape, but he pulled William to his feet and the two of them staggered out into the dawn. Only a few people were out this early, and those seemed unsurprised to see two men weaving up the street from the inn.

"What were you thinking?" Billy demanded as he dragged his companion out of town. "Lecturing the son of God about science. You—"

Then it hit him. "You planned this all along, didn't you?"

William shook his head. "Not quite. My plan was to get you close to Jesus so you could come to know him as a person. I figured if you did that, there was no way you would let him die on the cross. You would rescue him, and he would go on to the scandal and obscurity that all religious leaders eventually run afoul of." He turned to Billy, still walking, and said, "I figured Christianity wouldn't last a decade after his death if he got a chance to mess it up before he died. But when we got here, I realized I liked the guy. He's a decent sort, and he's intelligent, and his heart is in the right place. It's all the people who came after him who screwed things up. And he asked the right questions. So I decided to try a different approach."

Billy had to will himself to unclench his fists. "Your—your *arrogance* is beyond comprehension."

William nodded. "I'm sure it is. So is yours, to me. But maybe if the seeds I sewed tonight take root, we'll return to a world where science and religion spring from the same well. Where the answers to the deep philosophical questions are provisional answers, subject to change when more data comes along."

"The nature of God is not a provisional answer," Billy stated flatly.

"We'll see about that," said William. "I guess that's the core of this little experiment, isn't it?"

Billy couldn't find the voice to answer. The two of them trudged out of town toward their hidden time machine. When they reached it, they dug it out of the sand and unwrapped its plastic shroud, then dragged it back to a spot about four feet away from where they had arrived. "That should give us plenty of room to reappear in," William said. He gestured for Billy to step inside the cage.

Billy turned and looked back at the city of Jerusalem. The morning breeze off the Mediterranean was blowing the smoke from the night's heating fires away, as if the hand of God were removing a lid of darkness from the town.

"Dear Lord," he said softly, "may some good come of this, somewhere, somehow."

Then he entered the cage and stood there while William set up the jump. He watched William push the button, expecting the walls of the flat they had rented to blink into being around him, but instead, the desert around him merely sprouted greenery. He was standing in the midst of a lush forest, with sunlight filtering down through its canopy and birds singing merrily in its branches.

William was already standing before him. "We seem to have made a difference," the scientist said quietly.

Billy's heart was pounding hard enough to make him fear for his life, but he managed to steady his voice enough to say, "So we have." He turned once around, but he could see no sign of people anywhere. That meant practically nothing, since the forest was so thick it would have hidden a skyscraper a hundred yards away, but the stillness spooked him. Had humanity killed itself off in some titanic war a few centuries after Jesus established the doctrine of scientific revelation? Or had it learned how to live in harmony with nature, and he was now standing in the heart of a thriving metropolis?

There was only one way to find out. Billy held out his hand to his traveling companion. "Let's go see what kind of world our savior has created." ■

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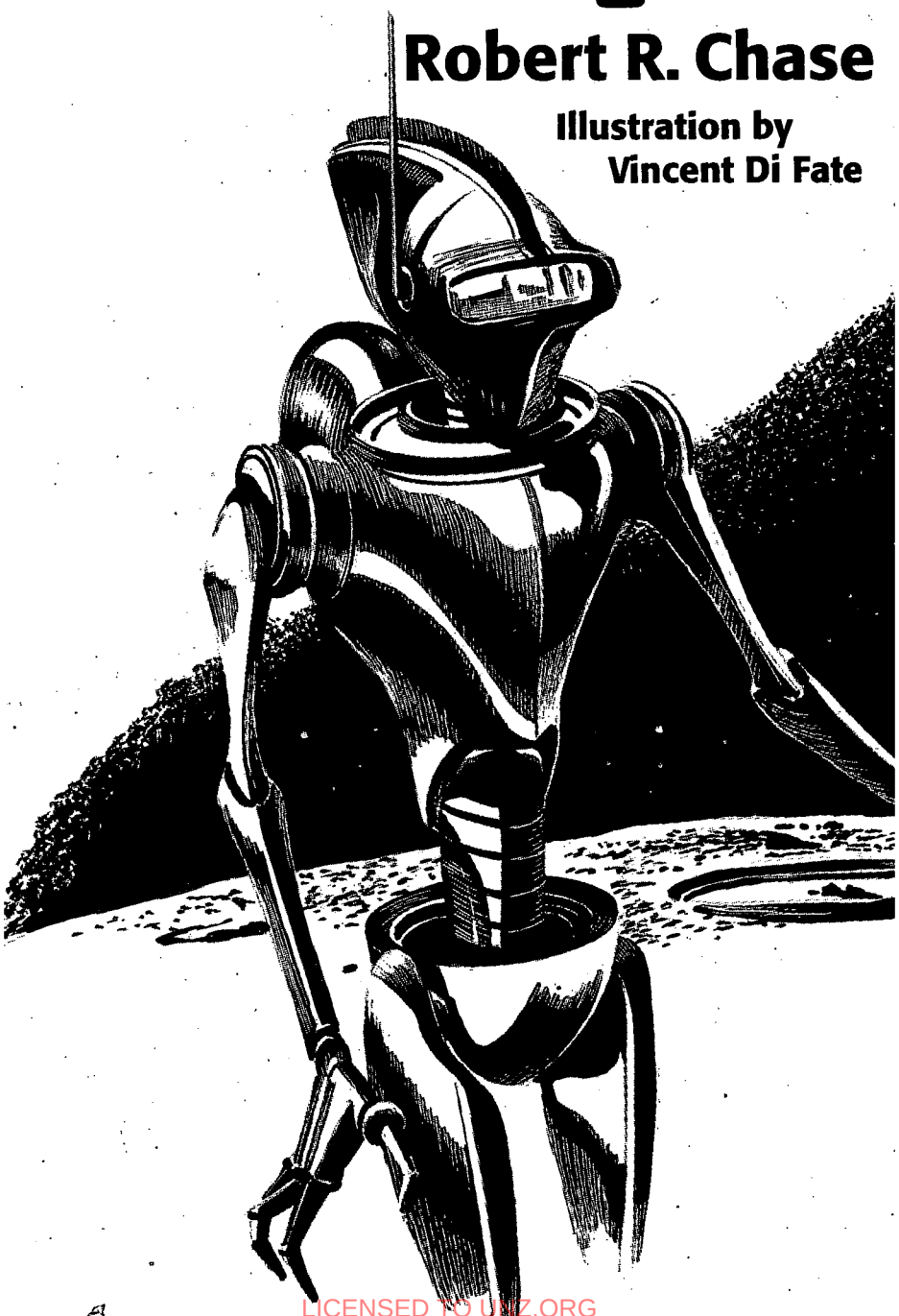
"Domo Arigato,"

Robert R. Chase

Illustration by
Vincent Di Fate



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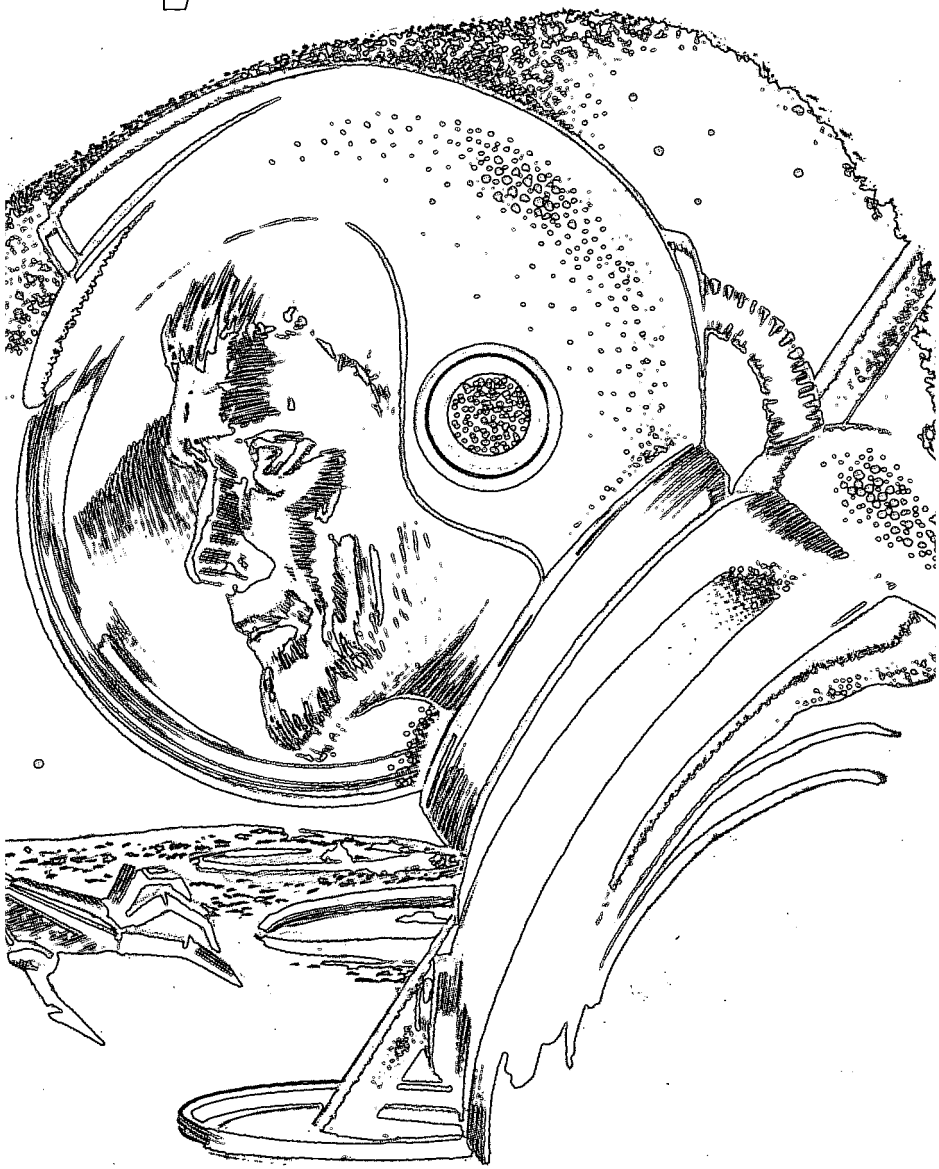
Says Mr. Roboto



The thing about legal games is that both sides can play them. . . .

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...Making adjustments to the landing sequence even though I'm not fully awake yet. That's the purpose of these repeated simulations. Make the responses so automatic that I can almost do them in my sleep.

There is also a reason why I am unconscious to begin with, though I can't think of it now. Not a problem. It's back there somewhere. It will surface if I really need it.

Squawk of static. "You there, Calley? Rise and shine, amigo, or you and Wildcat going to splatter yourselves all over the inner solar system."

Maria Theresa Gonzales. The sweetest voice conceivable to a boy a million kilometers from home. In my imagination, I see her in the communications center trailer, dedicated to the mission but eager to get off shift so she can work out to deal with what she imagines to be her weight problem. I shake my head, aware that I am just about to drift off. I try to answer, but my mouth is so dry that my tongue sticks to the roof of my mouth. Something between a grunt and groan emerges.

The numbers on the radar altimeter flicker too quickly to be read. I extend my hand to the control console. It feels like a block of wood, only now I am getting the pins and needles sensation as the blood flow returns. I flex my fingers to get more feeling into them. Hitting the wrong buttons now would be disastrous.

Here's the reason for the simulation. 2009 AP_{15} orbits the Sun at something like twenty-five kilometers per second depending on its position in its very elliptical orbit. Escape velocity from Earth is 11.2 kilometers per second and I will actually be going about thirteen kilometers per second. That may sound like I have a lot of delta vee to make up, but Earth itself orbits the Sun at twenty-nine kilometers per second in pretty much the same direction and plane as the asteroid. So I actually have to dump velocity by doing clever things with my launch time and slingshotting around the Moon, as well as the brute force expenditure of propellant.

When I get in the vicinity of the asteroid, I have to dock with it—I say "dock" rather than "land" because the surface gravity is nearly nonexistent. Since it has a six-hour rotational period, I descend in a controlled spiral, so as not to skip across the surface like a stone across a pond.

This could all be done by a computer program. There is a reason I have to do so much of it manually. That is something else I know that I know, even though I can't remember it right now.

I look up from the illuminated instrument panel, currently the only source of light in the cockpit, to check my approach through the window. The asteroid looks different from previous simulations. There is also a real surprise: another spacecraft, which, as I stare at it, is descending to the opposite side of the asteroid. The simulation team has never pulled that on me before.

". . . still getting high hibernadol readings from his breath." Maria is talking to someone in the trailer, apparently unaware that the mike is still on. "His body metabolized it more slowly than Doc Samuels predicted. Heart beat suggests he's conscious, though he hasn't responded to me yet."

I lick my lips to say something when an alarm goes off. Between watching the mystery spacecraft and listening to Maria, I have allowed the Wildcat to drift from the descent path. I feather the main engine to slow the rate of approach. The vibration is enough to shake loose the Saint Christopher medal Maria stuck on my instrument panel. It slams itself to the deck between my knees and then, as the engine cuts off, lazily bounces up, twinkling in the instrument lights as it spins.

Free fall! This isn't a simulation. This is the real thing. If I screw up, Wildcat

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and myself may smash ourselves into space debris. The beanstalk may never be built. Leastwise, not by my people.

"Whoa! Big pulse rate jump." J. P. Fetterman's deep voice has more spontaneous emotion than I have ever heard before. "You okay, son?"

I suck on the water tube inserted on the left side of my mouth. This time I get some words out. "A little busy just now minding your investment, J. P. Chat later."

Lightly, lightly, I touch the engine two more times until all lateral movement ceases and the rate of approach has slowed to less than a meter per second. There is a dull thump as landing struts swing out from the side of the craft.

When we make contact, I hardly notice it except for being pressed into my seat for an instant. Safety straps keep me from bouncing up a second later. The landing struts collapse part way into themselves to absorb the shock of contact. With surface gravity so low, the last thing we want is for the Wildcat to bounce all over the surface or even into orbit.

Everything settles down in the cockpit. When I see that the tell-tales are green, I zip on my pressure suit gloves and snap the helmet shut. It feels like two hands pressing on my ears as the suit pressurizes. Then I press the button to suck all the air out of the cabin.

"Not to push you or anything . . ." J. P. begins.

". . . but we are on a timeline," we say together. There is a five second pause as the signal bounces back and forth. "Right," J. P. says in the tone that is as close as he gets to apologetic. "Take the time to do everything right."

I unfold from the pilot's seat. My whole body feels the way my hands did earlier. Numbness gives way to a dozen varieties of pain and other discomfort. Strategically placed electrodes have stimulated major muscle groups while I slept, but muscles have already begun to atrophy, and bones to lose calcium. I stand for the first time in more than three weeks, brace my feet against the deck, and twist open the overhead hatch. It swings open, carrying me up and out. Not wanting to catapult into orbit, I grab an exterior rung and then hand over hand down the side of the Wildcat until my feet touch the surface. I reach down and gather powdery regolith into the palm of my right glove.

On cue, the required legalese begins to scroll across my helmet display. "I, James Calley, pursuant to Article III, Section 5, of the Treaty on Principles Governing the Use and Exploitation of Near Earth Objects, do hereby assert right of ownership over 2009 AP_{15} for the Beanstalk Development Corporation."

Just that easily, I assert J. P. Fetterman's claim for a four-kilometer asteroid.

"You know how to get ten billion dollars?" J. P. asked me, early in our relationship. "Well, you gotta start with a billion." This was neither a wisecrack nor a Zen koan. It was a succinct statement of a basic principle: once you have your first million, or billion, the second comes a lot easier. Aristotle was just wrong. Money *does* breed, at least when you have enough of it.

Getting "enough" is the problem and is directly relevant to J. P.'s difficulty with constructing a space elevator. Once the elevator is built, anyone who uses it will be, in the words of Robert A. Heinlein, halfway to anywhere in the solar system. Space travel will become a money-making proposition as costs plummet. The problem is that this "technological tower of Babel" (as it has been termed by a certain televangelist) cannot be built from the ground up. It has to be let down from heaven. Even with scramjet launchers, lifting enough mass into geosynchronous orbit to make an elevator nearly thirty-six thousand kilometers long will take more than Bill Gates–type wealth.

With a space elevator, one could be-

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come unimaginably wealthy—only it takes nearly unimaginable wealth to build the elevator.

This was only an academic problem until three different laboratories came up with ways of spinning out 99.99 percent defect free buckytubes of arbitrary length. Now there was a material that could be braided into cables strong enough to support a space elevator. Bright people all over the world began to concentrate on how the construction could be made affordable.

Since they were so bright, many of them came up with the same solution. Why go to all the trouble and expense shipping mass up from Earth when the raw material was already up there, just floating by? Earth-crossing asteroids contained everything needed. All you had to do was find the right one, the sort that chips off carbonaceous chondrite meteors, nudge it a little bit to get it into high Earth orbit, and set up a factory.

Observations were refined, calculations performed, presentations made. It was still going to be capital intensive, but it would not be prohibitive. Multibillionaires consolidated assets and prepared for a race. The space faring nations were too involved trying to salvage their social programs in the midst of a population implosion to be major players themselves. However, everyone agreed that the race needed rules. "We do not want near Earth space to resemble Dodge City," the French ambassador observed.

There were consultations. Negotiations. Compromises. Finally, a set of protocols matured into a treaty that everyone could more or less live with.

I thought it all unnecessary, especially when I launched and everyone else was scheduled to be at least a week behind. Only now there are two of us here, so maybe I was wrong.

The real work begins. Microgravity makes it hard, complicated, and boring. Suffice to say that after ten hours I have hauled an ion drive from Wildcat's storage hold to the edge of a crater, embedded it in the slope, and turned it on. If our astronomers are right, all rotation will stop in about six months. Then, when J. P.'s second set of wranglers come out here in the Cayuse, they will find it much easier to install their set of engines to nudge the asteroid into synchronous Earth orbit.

I make my way back to the Wildcat, pressurize the cabin, and strip off my space suit. Drops of sweat detach themselves from my forehead and hang in the air. I snag them with a towel, then wash myself as best I can with alcohol wipes. My hands tremble with fatigue. The work itself might not have been too strenuous for a man in good shape, but I have just come out of three weeks hibernation in microgravity. Weakened muscles are feeling the strain.

I sag into the pilot's seat. I am hungry in a distant way. I think I will do something about it after I close . . .

"Sorry to wake you up, Jimbo, but you have another little job to do." There is a false heartiness to J. P.'s voice, and there is something else about it that isn't false exactly, but sounds definitely odd. I have completed the mission profile. There should be nothing more for me to do other than run some last minute checks before heading back to Earth.

"You have a neighbor a little more than two clicks over on the far side. I'd like you to pay a visit."

If I keep my eyes closed, maybe I can convince both of us that I am still asleep. "Not protocol," I croak.

This is the absolute truth. As the race was heating up, there appeared to be a real possibility that three contestants might have ships on 2009 AP_{15} at the same time. Given how much success would mean to the winner and how great the financial penalty of failure would be to the losers, it had been decided to minimize temptation to all parties by keeping them apart. Especially

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since the prospector had to return to Earth alive to perfect his claim. When that provision had been made part of the treaty, the idea had been to discourage heroic sacrifices on the part of countries and companies that did not really have space faring capability. The realization that this might provide an incentive to sabotage and even murder came later.

I am about to drift off again when J. P.'s response comes through. "Changed circumstances. Look around and give me a report."

There is something very serious about his voice. I imagine him fiddling with his string tie, the way he does when he gets nervous. General weakness reminds me that it is three weeks since I had anything to eat. I pull out a bulb of Nutrasoup and stick it in the microwave for a minute.

"Might help if you were to tell me what I'm looking for." The microwave chimes. I take out the bulb and twist open the straw. Tasting slightly like a salty beef stew, Nutrasoup has all the proteins, vitamins, and electrolytes my body needs, while being digestible enough not to tie my abused intestinal system in knots.

"S'pose it might, but I can't say. Sometimes you just have to hold your cards and hope for the flop."

Now I am really concerned. J. P. may be a hard man, but he is not, by his own lights at least, an unreasonable one. He makes a point of explaining his view of the big picture so all his people will understand their place in it. For him to withhold information at a time like this goes against every business practice he believes in.

"I'm suiting up." Since it hasn't had time to dry out, it feels like putting on hockey gear that has been crammed into a too-small gym locker.

"Thanks, Jimbo. Maria is sending your directions now. A map will show you the easiest way to the landing site."

Alert enough to know that I am not really alert, I go through all the suit checks slowly. I recharge my suit jets. I have already expended more air that way than the mission profile called for. Not dangerously low yet.

I exit the ship. When I touch the ground, the interior of my faceplate lights up with a map showing my entire route and an arrow showing my starting direction. It mimics three-dimensional perspective: when I am lined up correctly, the arrow disappears and becomes a blinking dot. I aim at a bump on the (disconcertingly close) horizon and touch my jets.

When I was young, space seduced me through the silent majesty of the night sky. It was so beautiful and so mysterious that I could imagine nothing more worthwhile than exploring it. So I became a test pilot for one of the big aerospace conglomerates.

But a funny thing happened. It seemed like space retreated from me faster than I rose toward it. There was no silent majesty in the space station. It was one of the noisiest places I have ever been, even with the added sound baffles. When I was outside, there was constant radio noise, the sound of the helmet minifans, and my own Darth Vader-like breathing. The Sun washed out the stars, leaving only impenetrable blackness.

Now I am the first—well, maybe the second—human to explore this world, yet I feel apart from it. I can't walk across it because anything like a normal stride would have me soaring in high, time-consuming arcs. I have to use my jets with extreme caution to keep from flying off into deep space. Through my boots and thick gloves I cannot feel anything of this world, much less smell or taste it. The only sense that functions halfway decently is sight. And even then, it is more like seeing something through a view screen rather than experiencing it firsthand.

Alienated from my situation on an alien world. I should be able to get some

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sort of Ph.D. thesis out of that. But the truly alienating factor I keep coming back to is J. P. Fetterman's silence about what he wants from this little jaunt. My unidentified competitor and I arrived almost at the same time; radio logs back on Earth can establish actual priority. But perfecting a claim has three parts: you have to land on the asteroid; you have to "improve" it in some substantial way (killing its rotation constitutes such an improvement); and you have to get back alive. Unless a member of one expedition calls for aid from a member of a competing expedition (Article IV, Section 3, of the Treaty) it is best if members of competing expeditions stay far apart.

The map displayed on my helmet shows my destination is at one of the poles of the asteroid. $2009AP_{15}$ is roughly potato-shaped, and I am now coming to a section where the ground drops away more rapidly than on the plain where I landed. The Sun is behind me throwing forward tremendous shadows. Hills and ridges seem to float on a fathomless dark. As my boots brush the top of one ridge, I see something strange. It is some height above the ground, but I have nothing by which to judge size or distance. Imagine a horizontal silver line, brilliant with reflected sunlight. As I watch, it extends on both ends, adding about ten percent to its length.

The crest of another hill is fast approaching, and I concentrate on clearing it. When I can pay more attention to my surroundings, I see the pencil-thin shape of a spacecraft poking above the horizon. It sports a red disk on a white field. Below it, a large black numeral one, the symbol of the Ichiban Corporation. A Japanese rocket, which makes sense. After the Chinese entry, *Heavenly Gatherer,* blew up during a test firing, the Japanese were clearly our most important rivals. At the base of the rocket, barely visible in the reflected sunlight from its upper hull, lies a circular track about three meters in diameter. Rising up from the track, only intermittently discernable, are more than a score of lines, sheer and graceful as spider silk.

I don't know that I have said anything until I hear Maria's concerned voice in my earphones. *"¿Qué pasa,* Calley?"

It has taken me a few minutes to understand what I am seeing. "What we have here is industrial-strength origami," I report. "Ichiban has launched a solar sail, which is unfolding as it recedes from the asteroid. It is attached to the asteroid by lines anchored to a circular track. I bet the lines move around the circle against the asteroid's rotation to keep from getting tangled. As far as they are concerned, rotation is not a problem; they can start adjusting the orbit immediately. It's an elegant solution."

"We thought about doing the same thing," J. P. says glumly. "We just didn't feel we could get the sail to deploy properly. But that's neither here nor there. Who is operating the sail?"

I drift slowly toward to the base of the rocket, nudging myself off to one side to keep from getting entangled in the sail lines. Something moves in the shadows.

"It's a Gundam," I say, laughing. Then I correct myself. "Excuse me, it is a robot about three meters tall that looks like the robots in some cartoons I used to watch."

"Is it being operated by someone from Earth, or inside the ship?" J. P. asks.

Excellent question. While it is perfectly fine for an astronaut to have a robot on board for the grunt work—I would have appreciated having one myself—the rules were written specifically to prevent completely automated missions. Yet as I examine the spacecraft, I begin to appreciate how different it is from the Wildcat. No one is operating the robot from inside because, in one respect at least, the rocket has no inside. Engine and fuel tanks are exposed to space. Indentations in the fuselage and open binding rings disclose that all the items of the Ichiban expedition, solar sail and robot included, came fastened to the

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frame of the vessel. There is nothing like my pressurized cabin or anything that could be called enclosed storage areas.

I flex my legs to keep from bouncing as I come to the end of my long arc. The robot, which seems to have been monitoring the unfolding of the solar sail, turns and confronts me.

What do you say to a three-meter-tall robot, especially when the two of you are adversaries? I try the obvious. "*Kon nichi wa—*"

"You need not attempt the Japanese language." The words seem overly loud in my earphones. "I am fully conversant in standard English."

This is just as well. Even though everyone dealing in international affairs is supposed to know English, Chinese, and Japanese, I am more than a little rusty. "And who are you?" I ask, a bit taken aback.

"I am Hiro Ichiban. I have claimed 2009 AP_{15} for my principal, the Ichiban Corporation."

You have to be shitting me. Since I am broadcasting in clear to all of Earth, I manage not to say what I am thinking. "Look, pal, the rules are clear. No robotic missions. Your claim is invalid."

"I am not a mere robot. I am a fully autonomous artificial intelligence. I have been granted citizenship by the Japanese Diet."

"They can vote in favor of phlogiston for all I care," I say. "Legislative pronouncements don't make it so."

"You are talking to the robot as if it were a human being," J. P. says. "That might be considered by some as evidence that you consider it to be a true person."

"When I mash my thumb, I've been known to talk to my hammer," I say. "That doesn't make it either sentient or a citizen." His chuckle comes through my earphones a few seconds later.

Suddenly, everything falls into place. All the competitors have found it difficult to juggle payload with life support requirements. J. P.'s engineers solved the problem by putting me into three weeks' drug induced hibernation to save mass that would otherwise have been needed for food and water. Ichiban, which was having troubles with its proposed life support system anyway, apparently decided to do away with it, make everything payload, and have the Diet declare their robot a citizen.

Whether the legislative legerdemain will work is questionable, but one way to decide might be a version of the Turing Test. If I were to interact with the robot the way I would with a human being, it might give some presumptive validity to the Diet's action. Had J. P. briefed me on the situation, any negative reaction on my part would have been interpreted as being motivated by company loyalty. J. P. bet that he knew me well enough to go with my instinctive reaction.

He has reason for his confidence. The Artificial Intelligence Equality movement scares me. Robot pets for people who don't want the fuss of dealing with real animals, sex dolls for those not able to make themselves minimally acceptable to prospective partners, companions for the elderly who chose not to have children and now have no one to care for them. Workers for a society not able to maintain its own population and too racist to import foreigners. The AIE leaflets say that justice and equity require civil rights for A.I.s. My problem is not that they treat machines like people, it's that so many of them seem to treat people like machines.

Yet even if Ichiban's expedition violates the rules, it is still an impressive technical accomplishment. I move forward to examine the wheel anchoring the sail lines. A pressure just short of painful spreads from my right arm. I am motionless, less than a meter off the ground. It is hard to turn my head in the pressure suit, but from the corner of my eye I see Hiro's metal hand clamped on my forearm.

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"No one may approach the sail control mechanism," Hiro says. "It is a safety concern."

The pressure suit has a mesh lining to prevent tears. Still, the robot feels powerful enough to snap my arm while throwing me into deep space, if it wants to.

"What about programming to protect human beings?" I ask.

"I have such programming," the robot says. "To implement, I must first recognize a human being."

Its arm swings back and releases me. I retreat an extra step just to be safe. "My status is in doubt?"

"I see a humanoid form in a pressure suit. The suit covers too much for me to make a definitive assessment. It could conceal a primitive robot making programmed responses. Or it could cover up extensive body hair that would indicate one of the more primitive primates."

So a collection of circuits with preprogrammed responses is a citizen but the hirsute are not human. How wonderfully Japanese! After three weeks without a shave and more than that since my last haircut, maybe it is just as well that the pressure suit covers as much of me as it does.

"Your status is provisionally human," the robot continues. "My own status is not provisional. I must protect myself so that I may complete my mission."

Translation: If it comes to a choice between you and me, Round Eyes, you're going down. Not that surprising, I suppose.

I am about to ask J. P. if he has any further instructions, when Maria's voice comes over my earphones. "James, get back to the Wildcat immediately! A solar storm warning has just be issued."

There has always been a danger of solar flares. The Wildcat was designed to protect against them. Nobody ever considered that I would be this far from the spacecraft when I had to dive for cover.

I turn away from Hiro and the Ichiban rocket. The route back to the Wildcat flashes on the inside of my visor.

"How long do I have?"

"Thirty minutes. Hurry, *por favor.*"

Since I am retracing my steps, the return should be easier than the way out. Only the Sun is down near the horizon almost directly in my eyes. The glare makes it difficult to judge the height of the ridges. The thing that scares me most is that I will smash into a hillside. The second most scary thing is the possibility of jetting off into deep space. Sure, I could correct with a few puffs and send myself back down to the surface, but the amount of gas in my jet pack is limited, and the gauge is already edging toward the red line.

I get back to the Wildcat with seven minutes to spare. I pressurize the cabin and twist out of my spacesuit. My water supply for this voyage is kept in a jacket surrounding the cabin, where it does double duty shielding me from high-energy particles. Obviously this cannot include the entry hatch. There is a rectangular lead shield recessed in the overhead. I grab the handle, pull it over beneath the hatch, and lock it in place. I am as protected as I can be. I drift back into the control couch.

The original schedule had me on my way home by now. I understand why J. P. wanted to record my reaction to a robot claiming sentience and citizenship, but on reflection it might have been better to have me complete the flight checks and head back. It is the first contestant who lands on 2009 AP_{15}, improves it, and returns safely to Earth that perfects title in the asteroid. I am immobilized until the storm abates. Hiro may be long gone by then.

I discuss some of this with J. P. "The Hague isn't going to take this claim of robot citizenship seriously, is it?"

The pause is longer than lightspeed delay can account for. "Well, I dunno," J. P. says at last. "These Artificial Intelligence Activists are making a lot of noise, and not just in Japan. They got some

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bright folks saying this is the next step in evolution. And then there's the fact some of those judges just don't like us." By "us" he means Americans in general. "We've been on top for too long, and some would just like to see us shoved aside for any reason. Thing is, Ichiban doesn't have to win outright. They just have to tie up our claim with the lawyers and hope our investors bolt before theirs do."

The solar storm intensifies, drowning out his remaining words in a chaos of clicks, snaps, and eerie whistles. I am on my own. I fix another cup of Nutrasoup and activate the games menu. I choose poker from the long list that scrolls down the screen. Texas Hold 'Em. J. P. is the only one of the competitors to insist that his pilot candidates play a game with him during the hiring interview.

"This has nothing to do with my talents as a test pilot," I said as he shuffled and dealt.

"Not a test of skill," J. P. said as he picked up his cards. "It's a test of character. Y'see, you boys tend to go to extremes. Some are control freaks, absolutely brilliant, chess player types. Always planning five, ten moves ahead. Then something unexpected happens and they fall apart, crying that the universe is unfair."

I looked at my cards and mucked my hand. J. P. gave a small smile, took the minuscule pot, and dealt again.

"Then there are the plungers, the ones who believe in their own luck and think they can bluff their way through life. They have the most charming smiles. But their luck has to fail only once and they're done.

"I need a pilot who, with discipline and intelligence, tries to eliminate all the variables but doesn't go to pieces when that fails."

Of course, at the tables you have the option of standing up and bidding everyone good evening. Right now, that was an option I did not have.

This time, I had a pair of threes. I doubled the blind. J. P. doubled it back at me. That should mean he had at least a pair himself, almost certainly higher than mine. On the other hand, maybe he just wanted to push me around. I called.

The flop disclosed the Jack of spades, the nine of clubs, and the two of clubs. I checked. J. P. went all in. In a regular game, I would suppose that he had just picked up a card that made a strong hand nearly unbeatable. Nonetheless, it felt another attempt to scare me off. I pushed all my chips to the center of the table.

Ace of hearts, ten of hearts. J. P. threw down his cards: Queen of clubs and three of spades. A nothing hand. He looked more pleased than otherwise as I raked in the chips.

An ace and king unsuited appear on the screen. High cards, but it is depressing to remember how many hands I have lost from a similar start. The program asks me if I want to bet. I close my eyes, considering. All around me, an invisible storm surges. The high-energy protons are like hail drumming on the shell of the spacecraft. Then I notice that some of them are getting through the shielding. They look like birdshot sifting through the cabin, tearing painlessly through my flesh.

"Calley. Wake up, boy."

My eyes are gummy. When I manage to pry them open, I see the ace and king still on the screen, waiting patiently for my decision. The time display indicates that I slept for nine hours.

" 'm awake, J. P." I squint at the mini-kitchen control panel and punch up a bulb of hot coffee—as hot, that is, as I can have in the reduced air pressure of the cabin. Usually I take it with cream. This time, I leave it black.

"Right now there's enough of a lull in the storm that you should be able to complete your external take-off checks.

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However, the bright boys and girls at National Solar Observatory say it's going to start up again with a vengeance. I want you on the way home by then."

"No more assessment of Hiro Ichiban?" I suck the lukewarm coffee, waiting for his answer.

"No time. I've tried reasoning with Yoji—" This would be Yoji Ishikawa, the CEO of Ichiban. "—but he clammed up completely an hour ago. Y'know, his rocket landed at almost the same time yours did even though it launched three days later. They may not be able to put together a life support system worth a damn, but their craft clearly has more speed than ours. You take off just as soon as you safely can. If you get back before his ship does, we can avoid the entire folderol of whether a bunch of circuits can legitimately be claimed as a Japanese citizen."

I shrug on the spacesuit and exit the lock. It is night outside. Cold begins its caress of knees and elbows. The stars are hard and bright. High overhead is a blue-white dot, impossibly beautiful, impossibly far away. A bright rectangle of solar sail rises above the horizon. As much as Ichiban should not be able to perfect its claim, the Court will likely consider it unfair that Fetterman Enterprises should benefit from Ichiban's work. Most likely J. P. and Ishikawa will go into the electronic version of a closed room, large sums will change hands, and two smiling CEOs will announce a deal beneficial to the stock holders of both. J. P. is good at that sort of thing.

I switch on my helmet light and haul myself down the side of the Wildcat to begin my checks. Mostly this consists of making sure that the exterior compartments, the ones that housed the ion drive and its xenon propellant, are secured. I also inspect the rocket nozzles for corrosion, not that there is much I will be able to do if there are huge cracks.

As I move around the base of the Wildcat, sunlight sweeps across the plain behind me. The helmet fans purr to life a minute later. I am almost finished with my inspection when I find myself again in shadow.

"Calley, I just got a call from Mr. Ishikawa. He is very concerned about his mission and came close to accusing me of sabotage. Any idea what is going on with his spacecraft?"

I turn slowly. "I can't say about his spacecraft, but his robot is towering over me, no more than a meter from the Wildcat. You might ask your buddy Yoji what it's doing here. It's not exactly a comfortable sensation having it this close."

"Guh, guh, good . . ." The robot pauses. "Ohayo."

"Good morning," I agree. "What can I do for you?"

"There . . . there was . . . a storm."

"A solar flare," I say. "It kept me cooped up for most of a day. Protons do nasty things to human cells. Right now we're in a lull. I am trying to finish my preflight checks before it strengthens again."

If it is really that smart, it will make the inference that I wish to be left alone without my having to be blunt. Not that I believe in being polite to a machine, but my grandmother always said it was good practice no matter the audience.

"Hai." It takes me a moment to realize that this is an affirmative response. "I have . . . no shelter. The storm . . . impairs my function."

That should have occurred to me. Electronic circuits are in some ways as vulnerable to the effects of solar flares as I am.

"Are you saying the storm may kill you, end your functioning?"

"Yes. No. My function will . . . degrade. I . . . will no longer be . . . I."

For some, that would be a more frightening prospect than death. For the first time, I note dents on the metallic torso and dust on some of the joints. It has nothing like a jet pack. Learning to walk in microgravity has apparently

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been a difficult endeavor.

"I must protect myself so that I may complete my mission. You are sheltered from storm within your craft. Take me."

It was able to stop me without visible effort. It has the size and mass to toss me aside if it wants. If it really does not consider me human, there is no reason for it to practice restraint.

"The hatch is too small for you. And even if you could pass through it, you could never fit into the cabin. When I have my spacesuit on, I can hardly turn around." I think this is the truth, or pretty close to it.

"I did not mean the . . . shell. I . . . am . . . *contained* . . . in a central processing unit approximately seven centimeters by fifteen centimeters by three centimeters." Hiro puts its hands together to help a metrically challenged American visualize the size.

Then it says something odd. "I recognized that you were human when you . . . visited me. Pretending not to was a . . . ruse to make you uncertain, to ensure respect."

J. P.'s response to an earlier portion of the conversation reaches my earphones. "Under no circumstances are you to provide transportation to that can of circuits or to any part of it. If it threatens or harms you in any way I'll have Yoji's ass up on piracy charges."

Since we are all tuned to the same wavelength, I say: "You heard the boss. The answer is no. Sayonara, Hiro."

I turn to reenter the Wildcat. *"Kudasai,* Sensei."

Please, Master! An attempt to arouse pity mixed with some subtle flattery. It would not take a very sophisticated program to come up with that approach. I certainly would not be very sophisticated if I allowed myself to be moved by it.

I have my foot on the bottom rung. Slowly, I place it back on the regolith as I turn to face the robot.

"Hiro, you say you are a human, a citizen of Japan. Obviously, I have a different opinion. However, if you are a legal human, you have a right to contract. Do you understand what a contract is?"

There is a perceptible pause. "It is not a term in my database."

"My boss, Mr. J. P. Fetterman, sets a great deal of store on the right to contract. He considers it a right more ancient and more basic than those enshrined in the American Constitution. In fact, he has even been known to trace it back to Abraham cutting covenants with the Lord. It would be no exaggeration to say that Mr. Fetterman considers the ability to enter into a binding contract to be a defining mark of humanity.

"Basically, the idea is that two humans can exchange promises that will be considered binding in a court of law. For example, if I owned a farm, I could promise to sell you my entire rice crop for this year for thirty million yen."

"Wakarimasu ka?" "Tsukijanai." Hiro's handlers are discussing the situation and the conversation is leaking over their open line to the robot. I can't understand a word, but the tone of their voices tells me that they are unhappy.

"Does that explanation make sense to you?" I ask.

"Hai."

"Good. Now, I have something you want: safety from the solar storm and transportation back to Earth. What do you have of value to exchange?"

"I have nothing." I do not believe that the conglomeration of circuits standing before me is a person, is anything more than a sophisticated answering machine. Yet there is something about that answer so totally forlorn, so totally without hope, that I feel a chill.

"You're wrong. You have something of great value, but you just don't know it. As an employee of Ichiban, you have asserted a claim to this asteroid, which, if it is valid, matures into actual ownership if you return alive to Earth. If, however, you were to resign from Ichiban, accept employment with the Beanstalk Development Corporation, and assign any and all rights which may have ac-

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crued to you in 2009 AP_{15}, I would in return convey you safely to Earth inside my own spacecraft and make every effort to have your central processing unit rehoused in an appropriate robotic body."

"Hiro Ichiban, this is J. P. Fetterman, CEO of the Beanstalk Development Corporation. I want you to know that the man you are talking to, Mr. James Calley, is my agent for this matter and has full and complete authority to make offers of employment in my name under any terms he deems proper."

He could only have heard the beginning of my explanation when he launched that statement, but intuiting where I was going, immediately decided to back my play.

"If I perform my part of the . . . contract, how can I be sure . . . you will do as you say?" Hiro asks.

The shouting of Hiro's handlers crescendos, then is suddenly silent. "I have cut off that frequency," the robot says. "It was . . . distracting."

"It is the nature of contracts that each party's performance is conditioned on performance by the other party," I say. "If you do as I ask, but I fail to take you to Earth as I have promised, then your transfer of the claim to this asteroid becomes void. It is in my interest to do exactly as I have promised."

I measure the robot's silence by my heartbeats.

"I resign from Ichiban Corporation and accept employment from the Beanstalk Development Corporation. I transfer any rights I may have in 2009 AP_{15} to Beanstalk Corporation in exchange for being protected from this solar storm, being carried back to Earth, and being fitted into a body like the one I presently operate.

"Domo arigato, Sensei Calley," Hiro says. "Thank you very much."

The robot seems to settle into itself. A panel in its chest slides aside. Ichiban at least put the central processing unit in the most protected part of the shell. I reach in and gently disengage the CPU. All I can feel through my gloves is its mass, which somehow makes me fear that it may be delicate, that I must handle it very carefully.

"James Calley, this is Yoji Ishikawa. Cease your interference with my employee. If you continue with your current actions, you will be charged with sabotage, destruction of property, and malicious interference with contract. You will not be allowed to corrupt and destroy Hiro Ichiban with your lies."

"Too late, Mr. Ishikawa. The deal is done." Ishikawa's English is flawless, but there is something about the tone and phrasing that makes me think I am only a secondary audience. Much of this has been about influencing public opinion. I am willing to bet that right now both what he says and my replies are being broadcast all over the world. J. P.'s public affairs people will handle most of the response, but the boss undoubtedly expects me to carry part of the load.

"If you were concerned about your 'employee,' you would not have subjected it to conditions that would reduce it to the equivalent of drooling idiocy. I don't think I have the essence of a sentient being in my hands. Even so, I will treat it with more care than you choose to give to your fellow citizens."

High-sounding sentiments delivered with defiance and appropriate bluster. J. P. should be happy. I climb back into the Wildcat, secure the hatch, finish the instrument checks, and begin the launch sequence. Hiro's CPU is in my lap, secured by the safety netting. Hibernadol courses through my veins, blurring my vision, setting my thoughts adrift.

He disobeyed his handlers. The thought keeps recurring. Even though my Japanese is deficient, I know enough to know that they were telling him to ignore me and go back to his own craft. Instead, he shut them off.

As a nation, the Japanese are far ahead of all others in robotics, and Ishikawa

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pays for the best of the best. They would not expect to impress the Hague judges with Abe Lincoln at Disneyland crap. It would have to be orders of magnitude more sophisticated.

They say the best researchers use current generation AI programs to fashion the next generation programs. So, in a real sense, even the best human scientist does not fully understand what he is creating. And into this, throw random mutations caused by a solar flare. Ninety-nine times out of a hundred any such change should be harmful. But maybe that one time, a threshold will be crossed.

I cradle the CPU in my arms and fall into a dream of my first day at school. I run after a new friend, and when he turns to face me, his silver skin shines with the brilliance of the Sun. ■

When I was a boy I was told that anybody could become President; I'm beginning to believe.

—Clarence Darrow

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Reunion

David W. Goldman

Illustration by Nicholas Jainschigg

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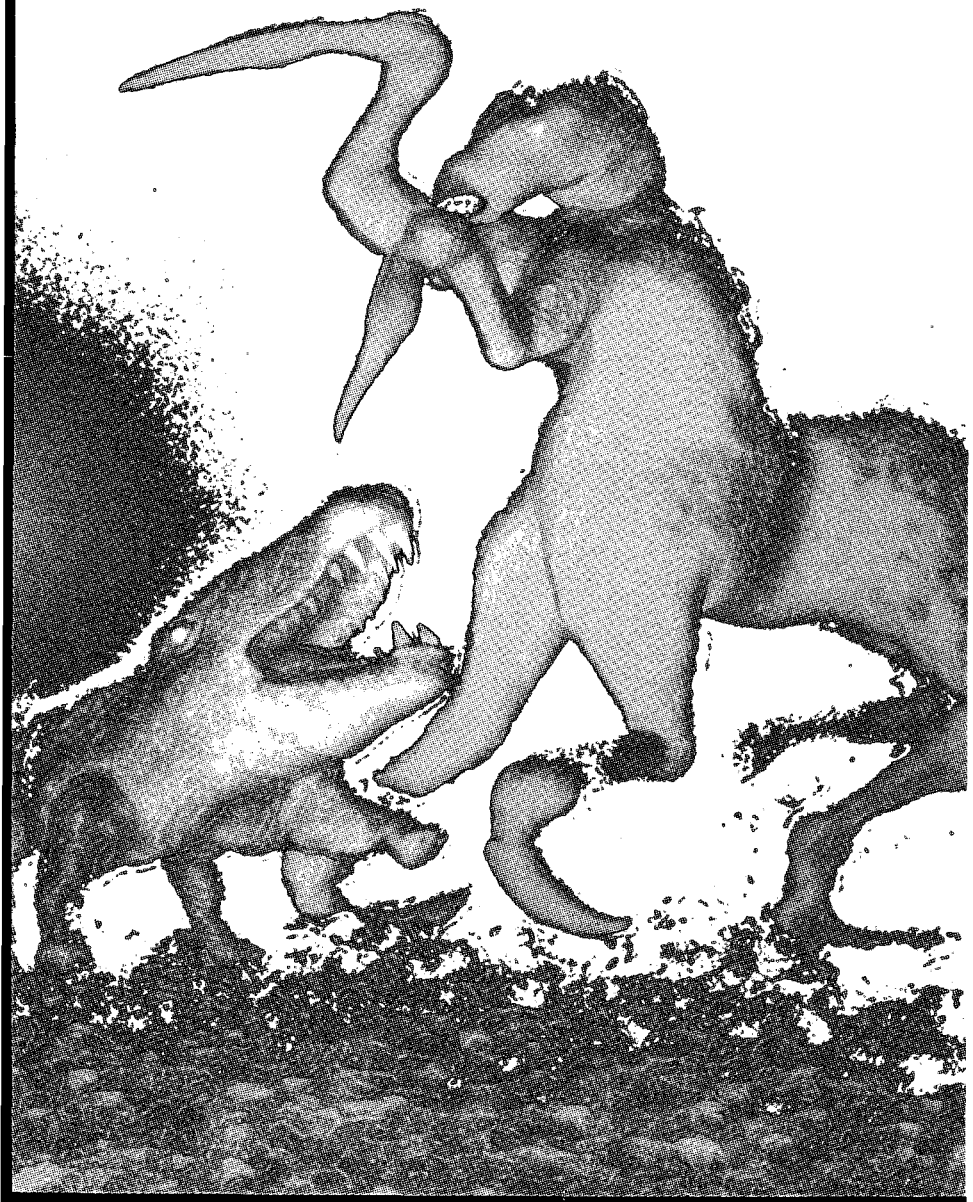
Sometimes the past just won't stay buried—and other times it gets buried with exceptional thoroughness. . . .



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I'd spent most of the morning supervising my desk as it attempted, so far unsuccessfully, to locate a replacement grinding arm for a broken ore mill. As usual with my clients' operations, the mill had been obsolete nearly as long as I'd been alive.

So when my office door squealed open and the short, neatly dressed man stepped in from the street, I was taking a much-deserved break. My feet were up on the desk; beside my bare calves and beat-up croc-leather boots floated a dozen dense lines of text and symbols that I'd been squinting at for half an hour.

"Ms. Dalmas?" the man inquired. He spoke softly, like someone accustomed to people paying close attention to his words.

Beneath his mahogany hair, the short man's face was obscured by the sentence *For m > 3, assume not.* I twirled my index finger in a gesture my desk understood; the text and symbols disappeared.

I replied, "So it says on the door."

His round, middle-aged face was deeply tanned, of course, but unlined. He turned it toward the door whose handle he still held, and nodded. "It also says *Expediter.*" He looked back at me. "I didn't think that asking questions was going to be *my* job."

I sighed and lowered my feet from the desk. "Right," I said. "Hello, good morning, I'm Jenna Dalmas. Welcome to my office; what can I do for you? Okay? Now would you please shut the damn door before my air-conditioning bill doubles?"

He responded with a genteel nod, as if I'd invited him in for lemonade. He pressed the door shut. But as he turned around he had a puzzled look. "This is air-conditioning?"

"Welcome to Hab Town," I said. "Not like the big city, huh?"

Lips pursed, he gave the room an unhurried once-over. There wasn't much to see. I rented the lower floor of one of the original colony habitats—one room for the office, three more, through a door to my right, for living quarters. A century of heat and reflected ultraviolet had matured the formerly white plastic walls to a mottled beige; the room's sole window, behind me, had long ago gone translucent. Two straight-backed chairs faced mine across the small ceramic desk that occupied most of the floor space. On the wall to my left hung a reproduced Earth travel poster, featuring a ski lodge behind falling snow.

The poster that I'd originally hung in that spot, when I first moved in, had advertised a fancy resort in some sun-drenched desert. After a couple of months, though, even I had no longer found the irony amusing.

He eased into one of the chairs. He wore the khaki shirt, shorts, and knee socks of any city worker. But his creases were all as sharp-edged as summer shadows; beneath a thin layer of dust his boots were polished to a gloss that in direct sunlight would be painful to view. At his hip he wore a covered holster—small and functional looking, not filigreed and oversized like the ones you usually see on visitors from the city. He sat erect but relaxed, as if I'd stepped into *his* office.

Gov admin, then. Maybe even Central Committee.

He said, "What I'm about to tell you remains confidential until the end of the year. Understood?"

I tilted back in my seat and just stared at him. He returned my gaze, his expression blankly patient. We did that for a while, then I decided to study the travel poster. I said, "I'm not working for you yet."

He nodded. "Actually, you are."

"Huh. Why's that?"

"Three reasons." He impressed me by not ticking them off on his fingers as he continued. "First, you're a week late on rent, and a hundred rips behind on the payments for that little motorcycle you ride. Second, you promised one of your clients that you could get him a city retail license—I can help you with that."

So—if not Central Committee, then at least one of the major subcommittees. I

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placed a mental bet on what he'd say next.

"And?" I asked.

"And third, I've recently received several disturbing reports of contraband software in this district. I'm sure that neither of us would want to see some zealous police investigator rummaging through, say, your desk here."

I nodded as I stacked my imaginary winnings.

"So," he said. "Confidential until the end of the year, yes?"

I shrugged. "Suppose we start with your name."

He surprised me with a genuinely friendly grin. With his curly hair and smooth skin, he suddenly looked ten years younger. "Jorge Garcia Ortega. Subcommittee on External Affairs."

I frowned. "This is about the Vulesk? I don't think my business license extends offworld, Mr. Ortega."

He shook his head. "Garcia Ortega. Or just Garcia. Or, if you like, Jorge. And no, not the Vulesk—not directly, anyhow. This can't wait five years."

He paused then, and his smile faded. I couldn't imagine what he was working himself up to tell me.

"The Warrant," he finally said. "It's missing."

I stared at his boyish face. I tried to keep my voice slow and easy. "Sparkly pyramid thing? About so big?" I held my hands out, half a meter apart. "Sits in the guarded case in the middle of the lobby of City Hall?"

He moistened his lips with a quick dart of his tongue. "That's a replica. The real Warrant stays in a high-security lab underground."

"Huh." That certainly made sense; I'd never actually given it any thought. "So five years from now, that incoming Vulesk ship is going to arrive in orbit and they're going to ask to examine our Warrant to confirm that we're an authorized colony. But you've, what?" I leaned forward, both palms now on the desk, and suddenly my voice was no longer as slow and easy as I'd intended. "You've accidentally *misplaced* it. Is that what you're telling me, Mr. Garcia Ortega?"

He flinched, but, I had to grant, only slightly.

"Swell," I said. "So when did you happen to notice that the Warrant was missing? And what the hell do you expect me to do that your people can't?"

He sat very still. He spoke very carefully, keeping his cool blue eyes on my face. "We noticed eighteen years ago. Right after the uprising."

A cold shiver danced up my back. But that was all. After eighteen years, I'd managed to squeeze everything into just a shiver.

Now it was my turn to speak very quietly. "If there's something you want to ask me . . ." My gaze was centered on his face. But I was watching his holster.

His arms didn't move. He shook his head. "Not you. You were merely a secondary participant, nowhere near the core organizers. If we thought you knew anything, you would have heard from us a long time ago."

For another few seconds I stared at him. Then I exhaled and eased back into my chair.

He seemed to relax a bit, too; his tone became more conversational. "When the Committee Police retook City Hall, we saw that the replica was gone. But the original remained secure. Things were chaotic; several days passed before someone realized that what we had in the lab was actually the replica. Unfortunately, by then . . ." There he let it go, maybe to spare my feelings.

I finished it for him. "Unfortunately, by then your thirty best leads had been executed." I was just reciting a fact. Not recalling any sights, any sounds, or smells. Just feeling that cold shiver.

He nodded. "Whoever took the Warrant did a damn good job hiding it. Still, we thought we had plenty of time to find it. The Vulesk patrols are supposed to average three hundred years between visits—what were the odds they'd show up

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this soon?"

I gritted my teeth. I hated that phrase: *what were the odds?* People always say it as if "the odds" were some mysteriously infinitesimal percentage you'd need a supercomputer to calculate.

He didn't seem to notice my reaction. He continued, "Since we detected the Vulesk ship last month, we've had to broaden the investigation. If nothing turns up by the end of the year, we'll make a public announcement and offer rewards. But for now, none of this gets out."

I drummed my fingers against the arm of my chair. "All these years—nobody's contacted you?"

"No. We were hoping that the appearance of this ship would prompt some action, but it hasn't yet. Of course, they still have five years to make us sweat before they name a price."

"Assuming 'they' are still alive."

"Yes. Assuming."

I sighed and stared at the ski lodge. "You think people will talk to me. That they'll tell me things they wouldn't tell you."

He shrugged. "It's worth a try."

He was wrong. For eighteen years, none of us had been interested in talking to one another.

I drummed my fingers some more. "This isn't what I do, Mr. Garcia Ortega. When somebody's antique optical-fiber extruder breaks, I track down obsolete replacement parts, or I rewrite their control software to work around the problem. When a business wants to expand, I figure out who they need to bribe. But apart from the time I helped my neighbor find her lost canary-snake, I don't do mysteries." Or take jobs for the Central Committee—especially jobs guaranteed to stir up old memories.

He nodded, a gesture that by now I didn't find reassuring. "I understand." He stood. "Too bad, though. I'd heard that you're quite resourceful when it comes to finding things. And also that you're very good with software." He gave my desk a meaningful glance.

Damn. Over the years I'd tunneled into half the warehouse databases in the city, plus a couple of the lower-level municipal ones. The Committee never threatened idly—if he did send in the police to sift through my desk, without giving me time to tidy up first, then for the next six to twelve years my mail would be forwarded to me in care of Sandcastle labor camp.

I said, "You were mentioning rewards . . ."

He lowered himself back into the chair. "Five hundred as a retainer. Real money, of course; not rips. Another five hundred per week, as long as you've got even a hint of a lead."

"Plus expenses."

"I don't think so."

It had been worth a try. "And if I actually find it for you?"

"Seventy-five thousand for information leading to recovery. Hand it over to us yourself, a hundred fifty."

"One hundred and fifty thousand kiloliters . . ." I nodded. I'm sure he thought I was working hard at my lack of enthusiasm. But, really, all I was considering was the five hundred per week.

I shook my head. "I can't ask the right questions if I have to keep your secret."

He spread his hands in the air above his lap. "Be as discreet as possible. In private conversations, say what you need to say. We can live with rumors."

I pushed my palms against the desk and stood. "I'll need everything you've already got."

He reached into a pocket, placed a data crystal onto my desk. Then he stood, too. The top of his head came almost to my chin.

He glanced at my waist. His eyebrows lifted slightly. "No gun?"

"No."

His eyes narrowed, but he simply said, "Keep in touch." He reached across the desk to shake hands. His grip was firm and dry.

After he let himself out, I stood there a

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minute, eyeing the crystal. I wasn't particularly eager to review its contents. Doing that would give me a lot of things to think about—most of them things I'd spent almost two decades working hard at *not* thinking about.

But finally I sat and gestured my desk to show me the crystal's directory. Most of the entries were people's names. I took a deep breath, then reached into the projected image and flipped through the listing, pausing here and there to recall a face. And although a dozen of the names did cause me to catch my breath—friends and classmates I'd managed to keep out of my thoughts for years now, at least on most days—the rest were merely people I used to know a little, a long time ago. Really no big deal at all.

Huh.

I pulled up some of the reports attached to the names. These were summaries of interviews—including surreptitious monitoring of pulse, respiration, and voice stress—with the Warrant showing up here and there amidst long lists of questions. Nobody ever seemed to react to its mention.

Besides the names and reports, the crystal included a section on the Warrant itself. Its image rotated lazily above my desk—a truncated pyramid of tight-packed, knuckle-sized gems in a variety of colors and cuts. Some of the Warrant's physical measurements were included, but I could find very little about its most intriguing property.

The Vulesk had presented the Warrant to my great-grandparents and their ten thousand fellow colonists right after delivering them here, just before the last of the huge Vulesk shuttles had restarted their mysterious engines and departed. For the first few months the Warrant received little attention, everyone being otherwise occupied in setting up the colony. And, of course, in dealing with the gradual realization that while the enigmatic Vulesk had, as contracted, dropped the colonists in a region of the planet at least marginally suited to humans and our carefully planned, decentralized agricultural settlement, nearly all of the territory's accessible water lay locked beyond a mountain range three hundred kilometers to the west—in a region considerably less suited to emigrants from Earth.

So the Warrant was put into storage and ignored while the colonists erected their habitats in a tight cluster around the few local water sources, and while they established a committee to organize the building of aqueducts. And it remained in storage two years later, when that committee requested its own police squad to enforce equitable water distribution. By the time things eventually settled down enough for scientific inquiry, not much remained of the colony's original plans for a sparsely rural, loose-knit, barter-based community.

Once taken out and finally studied, the Warrant quickly disclosed its nature—it was an active electromagnetic transponder. Expose it to a beam of light, or of radio or x-rays, and the Warrant bounced back a new beam—but with a frequency shifted slightly from the original. While any particular incoming frequency would always shift by a reproducible amount, though, a closely neighboring frequency would be altered to a completely different degree. Overall the shifts followed no pattern; the Warrant behaved as if it held a vast, randomly generated table of incoming frequencies and their corresponding shifts.

Some experiments also suggested that the Warrant possessed similar frequency-shifting properties in other domains. For example, subatomic particles, when bounced off the Warrant's surface, changed their velocities in an unpredictable but reproducible fashion.

But before long, the Central Committee halted further research into the Warrant. Fake Vulesk Warrants, they argued, were supposed to be impossible for an unauthorized colony to forge. Now that we understood why—our Warrant's spe-

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cific electromagnetic frequency shifts, plus whatever other properties it might prove to manifest, added up to a unique signature that a Vulesk inspector could verify—we would be acting against our own interests if we continued to accumulate exactly the data that a hypothetical forger would love to steal from us.

Nobody knew for sure what the Vulesk would do upon finding a colony that couldn't prove it had been authorized by a Vulesk representative. The Vulesk's apparent aversion to aggression and chaos, which seemed to lay behind their monopolistic control of colonization in this part of the galaxy, had led to a general human expectation that unauthorized colonies would be shipped back to their homeworlds—as opposed, say, to simply being incinerated in place. But in their characteristically oblique communications, the Vulesk had never unambiguously confirmed our guesses.

Given the Committee's attitude toward the Warrant's secrets, I wasn't surprised that Garcia Ortega's crystal failed to list any details of the Warrant's frequency shifts. But he had, it turned out, given me more than merely data. According to an explanatory file, his crystal, socketed into a standard handheld scanner, could program that scanner to generate a short sequence of radio frequencies and then check the shifts of any returned signals. Should I actually come across what appeared to be the Warrant, I'd at least be able to rule out a gross forgery.

Shaking my head at the impossibility of this entire job, I plucked the data crystal from my desk and for a few seconds tossed it back and forth between my hands. Then I shrugged. I rummaged through desk drawers until I found a beat-up scanner. I inserted the crystal. Then, for lack of any better target, I pointed the scanner at my travel poster and triggered the sequence.

The scanner's display read "negative"—apparently this particular ski lodge held no Warrants. Oh well. I powered off the scanner and, after another shrug, dropped it into a pocket of my shorts.

It occurred to me that hidden beneath the false bottom of my middle drawer lay a few other items that might come in handy. Given to me four years ago by one of my less savory but unfortunately well-connected clients, in appreciation of my obtaining—to my subsequent regret—a certain pharmaceutical for him, they weren't anything I'd ever had a use for. But if now I was to play private investigator, then I supposed that a few basic breaking-and-entering tools might prove helpful. I added them to my pockets.

I sat back and considered where to begin my investigation. The obvious approach would be to start with the Thirty. Review everything I could find or remember about each of them; try to guess who might have been involved in stealing the Warrant. Then determine their closest associates among the survivors and start interviewing.

But that was exactly the approach Garcia Ortega's people would have already tried. I could fall back to that strategy later; for now it didn't excite me.

No, I decided, it wasn't time yet for analytic approaches. What I needed to do at this stage was poke around randomly in the problem space. Build up my knowledge base, give my subconscious something to work with.

I pulled up the twelve names that had struck me earlier. For each one, I told the desk to fetch anything it could find from the public nets.

I spent the next hour flipping through the results. And felt a growing claustrophobia as I read through a dozen very different life stories up until eighteen years ago—and then, apart from variations in names and places and occupations, the same too-familiar story a dozen times over.

I picked one of the names: Paul Stein. He'd been a grad student in physics; his department, like mine, had required a year of applied math. I remembered get-

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ting together a few times after class for lunch, where we'd argued about politics. I told my desk to phone him.

He answered right away. "Yes?" From the images my desk had retrieved, I already knew to expect the beard he'd acquired somewhere over the years. But he needed more than a few seconds to extrapolate my short, faded hair backwards in time—he frowned, obviously trying to place me.

"Paul," I said.

My voice, apparently, sufficed as a final clue. He leaned forward. *"Jenna?"*

I forced myself to smile. "How have you been?"

His eyes widened. "Why are you calling?"

"I've just been thinking that, maybe, it would be good for some of us to get together. Just to talk, you know?"

"No, I—" He pulled back, and his hand came up to tug at his beard. "This isn't a good time."

"I can call back later. When would—"

He shook his head. "Sorry." His breaths now were faster, shallow. "Some other time, maybe. I just—" He wiped his forehead. "Sorry," he repeated, and then he hung up.

I sat there, staring through the space where his image had floated and cursed my stupidity. Okay, so maybe I finally seemed to be ready to start coping with the past—how did that imply that anyone else was on the same schedule?

I got up and paced for a few minutes. Then I returned to my desk and put together a text message. I tweaked the wording several times, keeping it short, trying to remove anything potentially threatening, any sensory hooks to past events:

Former colleague interested in getting together with others to talk, catch up. Will not contact you again, unless you reply to indicate your own interest.

I gave it one more read, then gestured my desk to send it to the eleven remaining addresses. But my nervousness made my hand shaky; I had to take a long breath and then repeat my gestures before the desk understood.

I tilted my chair back, wondering what else I could pursue over the coming hours. The desk chimed. Incoming text:

yes yes yes! when? today?

Huh. Apparently somebody had been following an even faster recovery schedule than I had.

The sender was Tamiko Hoshida. Botany, I recalled. Or maybe genetics. She had lived only a few doors from my apartment; we'd often walked home together after late nights in the library.

Sure, I sent. *Lunch?*

She replied with the name and address of a restaurant. We agreed to meet in an hour.

The restaurant sat beside a plaza on the south rim of Hab Town. Twice on the way there I had to pull my motorbike to the side of the road: first on a side street leading to Ventura Boulevard, where a tow truck was hauling away the remains of a delivery van and the ankylosaurid into which it had crashed—more and more fauna had been wandering into town lately, as their browse retreated underground for the summer—and then a second time, just a few blocks from the plaza, to let a double-wide mining transport trundle past on its way to the smelter.

I parked my bike beside one of the scraggly wirewisp bushes that lined the edge of the plaza. A herd of young kids were chasing each other and a ball back and forth across the crumbling yellow bricks; their shouts' echoes off the surrounding two-story habs seemed to triple their numbers. I paused a moment to watch. Which of them, I wondered, might children of mine have resembled? That tall girl kicking the ball past the others? Or maybe the scrawny boy lagging behind the pack? I glanced up at the cloudless sky and hoped that all of their parents had been keeping their children's skin treatments up to date.

About half the buildings sported busi-

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ness signs. From my corner of the plaza I could see two dry cleaners, an appliance repair shop, and a run-down grocery. An old man sat in front of an unmarked hab, sipping from a bottle as his head swiveled to follow the kids and their ball. High upon the wall above him, something that in the city I'd barely have noticed: a camera surveilling from its windproof shell.

I skirted the game, nodding hello to a bored-looking young woman behind an ice-water cart. A whiff of fresh-baked tortillas drew me past two more buildings to the restaurant.

The interior was dim, and about ten degrees less stifling than outdoors. I dropped my sunglasses into my shirt pocket and started to look around.

"Jenna!" A thin woman with a long, black ponytail jumped up from her seat at one of the half dozen crowded tables, waving both arms at me. I winced—I'd forgotten about Tamiko's tendency toward enthusiasm.

Squeezing between the tables, I reached out my hand. "Tamiko—"

She grabbed me in a tight hug. "All these years! It's *so* good to *see* you again!" Then, maybe registering what she'd just said, she held me out at arm's-length and gazed at my face, grinning the whole time. And then she hugged me again.

I finally managed to escape her embrace. Shaking my head, I told her, "You haven't changed at all."

She wore a pair of emerald coveralls with *Hoshida Recycling and Scrap Metals* embroidered in powder blue over her left breast. Her face actually hadn't altered much over two decades; her black mane, though, now held several strands of silver.

"You haven't changed either," she lied. "How do you manage to—?"

I held up a hand. "First we order. Or else we never will." She pouted as I sat and handed her a menu. But within a few seconds she was leaning across the table and raving to me about the chef's grilled salmon-lizard with persimmons.

Once our orders had been placed, we told each other all about our lives since we'd last been in contact—both of us politely pretending that we hadn't already looked up the other's public history an hour ago. Neither of us paid much attention to the food that we took turns consuming while the other spoke.

After a convenient interruption by our waiter, I asked, as casually as I could, "Did you ever hear that rumor about the Warrant?"

She looked genuinely mystified. "The Warrant? What rumor?"

"Supposedly one of us stole it, back then, and left a replica in its place. And, supposedly, it's still missing."

"But why . . ." She gave it a few seconds thought, then nodded. "Actually, that would've been a smart move, once it became obvious that we weren't going to hold onto power. If someday we ever regained control, then eventually we'd need the Warrant; best to keep it close. And if not—" She grinned at me. "—well, there's always extortion, isn't there?"

I raised my eyebrows. "Sure, if you can convince the Committee that you're prepared to suffer, or die, along with the rest of the populace. Tricky, though, to launder a ransom in such a small colony."

She gave me a wink. "Oh, I bet that you or I might know a few people who could help with that. But I wasn't necessarily thinking money."

Something in her tone, or the gleam in her eyes, froze my spine.

She leaned forward, lowered her voice. "Suppose the ransomer demanded political changes? I mean real changes, like a freely elected Central Committee, or disbanding the Committee Police—not the sorts of thing you could simply reverse as soon as the Warrant was delivered."

I sat paralyzed for a second, panicked by this turn in the conversation. Then I forced myself to exhale and smile. "Well, I guess that proves it's all just a rumor, af-

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ter all. Because I sure haven't seen any changes."

She smiled back. But she still looked thoughtful.

Quickly, I said, "Speaking of changes, do you remember that guy who lived in the apartment above yours? What was his name—Vince? Vick?"

"Yeah . . . oh—Vincente! Wow, I haven't thought about him for a long time. You remember that mustache?"

Eventually, after we'd finished dessert and paid—in rips, though this restaurant saw enough city customers to also list prices in kiloliters—and after the waiter had refilled our teacups for the third or fourth time, the weight of our meals and of our lives settled over us and we both fell silent for a few minutes. Tamiko toyed with a spoon, twirling it slowly against the tablecloth. I folded and refolded my napkin into random shapes.

Her gaze on her spoon, she finally said, "Do you think they already had it all planned? When they let us go back, I mean, and finish our degrees." She looked up. "You were doing topology or something, right?"

"Group theory."

She frowned. "I thought that had all been completed, back before anyone left Earth."

I sighed and was about to launch into my usual response to that common misunderstanding, when I realized just how long it had been since someone had provoked that response from me—our conversation really had taken me back in time. So I simply said, "No. Not quite all."

She nodded acknowledgement, then shrugged. "So, anyhow, they let us all return to the university. But none of us liked being reminded of what had happened. We avoided each other, fell completely out of touch." She glanced downward. "Lately, though, I've done some checking. And, well, now I think that probably everyone went through the same things I did." Her gaze returned to my face, intense now. "You forced yourself to focus on your studies, right? And after a few years finally you graduated and went looking for work in your field. Or in anything close to your field. Or, finally, in anything at all. But somehow there was always a problem with the paperwork, wasn't there? Or you were overqualified, or the funding had just fallen through . . . Before long, you couldn't afford to keep living in the city." She paused to peer into her spoon, as if it held a scoop of the past. Then she looked back up at me. "So—do you think they already had that all planned for us, right from the start?"

Her words were making my stomach tighten in a very unpleasant way. "Just stop."

She looked puzzled. And maybe a little hurt.

"There's no point asking questions like that," I said. "This is their world—we forced them to remind us of that, once. We're not supposed to forget again, not ever. Thinking about what happened, bringing everything all back up again, asking questions like yours—that's no good. It only . . . look, really, there's just no point."

She peered at me for a moment, then disappointment overran her expression. She bowed her head to stare again at her spoon.

It struck me that this job was probably going to be full of cheery moments like this.

I pushed back from the table. "Tamiko, I'm sorry. Really, it's been great seeing you again. I'm just not very good at—I'll call you, okay?"

She looked up at me, but her thoughts were somewhere else. I took advantage of her distraction and left before she started asking more questions.

Emerging from the restaurant was like stepping directly in front of a blazing searchlight. I grabbed for my sunglasses; by the time I had them on I already felt sweat sliding down my back.

The kids had taken their ball someplace else. Now a few dozen swing-shift workers crisscrossed the plaza; the

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woman behind the ice-water cart was being kept busy.

I'd gotten a third of the way across the plaza when from behind I heard, "Jenna, wait!" I stopped and with a sigh I turned.

Tamiko waved an arm above her head as she jogged toward me. She was, I realized afterward, by far the most animated thing on the plaza. So it was no coincidence that when the shooting started, it all centered on her.

Seeing that I'd stopped, she slowed to a walk. In the same instant, from the corner of my eye I saw a powerful, elongated form hurl itself from behind a bush to fly toward Tamiko in a low, brown-striped arc.

The first shot came from off to my left. Then two more from the other side, simultaneous with the sizzle of a maser from somebody behind Tamiko.

The croc slammed into the plaza's bricks and skidded to rest a meter from Tamiko's side. She'd frozen at the sound of gunfire all around her; now she jumped backward with a scream. One side of her green coveralls was spattered with black blood.

In the ensuing brief moment of stillness, as my heart slammed against my shuddering ribs and my vision's dark rim slowly cleared, I noticed that Tamiko—who stood mesmerized before the pile of scales, muscle, and teeth splayed within the dark stain that was slowly spreading across the yellow bricks—wore no gun.

I rushed to her side, nearly colliding with a tall young man with shoulder-length red hair who was returning his weapon to its holster. Tamiko still stared down at the croc; when I spoke her name her wide-eyed gaze snapped to my face. More blood streaked her cheek.

"Come on," I said. "I'll give you a ride home."

Over the next few days I met with two others who answered my message. The first, once a promising scholar of twenty-first-century West African literature, now ran a small-engine repair service. We met at his shop. I couldn't get him to talk about anything other than motors and lubrication.

My other interviewee was Rafe Lindquist. Zoology student turned kiln operator. We'd once known each other slightly, through a mutual acquaintance and a few rather dismal parties. He'd put on several kilos since then, but he kept his still-black goatee precisely trimmed, and he dressed as fastidiously as I recalled—his unwrinkled, pale blue shirt carefully tucked into the waistband of his neatly pressed, darker blue shorts. When he pulled his chair out from the small café table, though, I'd noticed a streak of soot across one shoulder blade.

Rafe had an intriguing reaction when I mentioned the "rumor" about the Warrant. At first he simply looked blank. But after a couple of seconds, as I was about to take the conversation somewhere else, he cocked his head and said, "Maybe that's what he was talking about . . ."

I waited, but he just sat there looking thoughtful. So finally I asked, "Who?"

He studied me, tapping his finger on the tabletop. "Somebody who'd had a little too much to smoke one night, by a campfire." Then he glanced around the busy café. "I'd like to compare notes with you. But not here. Can you meet me at my hab tonight—say, between seven and eight?"

And then *he* changed the topic.

After we parted, I shared a frustrating afternoon with my desk as together we failed to hunt up a single clue as to Rafe's mysterious informant.

The sun was setting when I pushed my bike up onto its kickstand. Long shadows stretched down the alley; a warm breeze blew a scrap of paper along the road's reddened edge. From a line of nearby bins wafted the thin, sweet smell of garbage.

I climbed the rickety steel stairs to Rafe's upper-floor apartment. He didn't answer when I buzzed, or when I knocked. My watch showed seven-forty.

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I tried the door—locked.

For half an hour I leaned back against his door, keeping an eye on the alley in both directions. Apart from the muffled music coming from the hab next door, I seemed to have the darkening evening to myself.

I gave the buzzer another chance; I could hear it echoing hollowly inside the hab. Somehow it didn't sound right to me. Maybe I'd caught some of Rafe's paranoia from the café.

I glanced up and down the street, searching one last time for any obvious cameras. Then I unfastened a pocket and extracted something that looked a lot like a standard key card. Hiding my actions with my body, I held the card over the door's lock. A few seconds passed while an arcane electronic mating ritual was consummated; then the door emitted a soft, satisfied click and the lock retracted its bolt.

I stepped into the dark apartment, used an elbow to push the door closed behind me as the lights came up. There was a funny scent in the air, too faint for me to name.

I found myself in a living room spartan in its furnishings, though not currently at its most presentable. A steel endtable lay on its side; one of the couch's burgundy-upholstered cushions had slid to the floor. Beside it laid a scatter of data crystals that I guessed had been swept from the nearby wall-hung desk, along with a couple of image-frames and a brown-striped, fuzzy toy croc.

I stepped carefully through the debris, glancing into the adjoining kitchen as I passed its doorway. Nothing obviously amiss in there. When I arrived at the closed door to what in most habs would be the bedroom, I paused. Reaching into a pocket of my shorts—the same one holding the scanner and its crystal—I pulled out a small canister and sprayed a pair of gloves over my hands.

No sounds emerged through the thick plastic door. I pressed my gloved hand lightly against it; the door swung partway open to reveal the corner of a bed, along with a fuller perfume of the odor I'd been smelling—cinnamon, mixed with rotten peaches.

I'd encountered that smell once before, four years earlier. At the memory my heart began hammering; my hand trembled as I pushed the door fully open.

Rafe Lindquist lay on the bed, curled on his side, staring at me wide-eyed. One arm extended across the bed, the hand reaching in my direction. His other hand was pressed to the front of his neck like someone choking—which he had been, when he'd died.

His dark blue shorts were rumpled. His shirt was half untucked.

I spun away and squeezed my eyes shut, taking gasping breaths through my mouth to avoid the now cloying odor. Then I forced myself to turn back and step closer. Gagging at the touch, I checked his neck—pulseless, but still warm.

If I'd arrived just a little earlier, might I have run into his killer exiting the hab? A little earlier yet, might I have prevented this?

Still shaking, I cursed the intruder whose clumsiness had left those questions lying here in wait for me.

I made myself give the bedroom a once-over. Other than the bed, though, it didn't hold anything interesting. The contents of Rafe's pockets had been strewn beside him: a few cards, a pocket multitool, some cash-crystals—nothing interesting there, either.

I returned to the living room, pulling the bedroom door closed behind me. I stood still a moment and waited for my heart to slow, my neck muscles to loosen.

I reached down to the floor and flipped over one of the fallen image-frames. It was cycling through eight images of smiling faces of various ages, shapes, and sizes. Family members? Friends? I pulled out my scanner and recorded them all.

The other frame held only a single

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shot. Rafe—without the extra kilos—and a tall, craggy-faced man whose graying temples contrasted with his ebony skin. Both of them wore serious boots and roughed-up field clothes as they squatted before a desolate landscape of sepia dirt and scruffy bushes. Between them sat three half-buried bluish spheres—the eggs, presumably, of some desert monstrosity. The two men were grinning like kids who'd just stumbled upon an unexpected freezer-load of ice cream. Across the image someone had hand written "To my best student."

I considered that inscription as I ran my scanner over the frame and over the crystals lying beside it. I didn't recognize the older man. I stood and surveyed the room until I spotted a familiar small gray ceramic box sitting on a high shelf by the front door. I took down the box and lifted its lid—embossed with the university's crest—to reveal the data crystal inside. I closed the box but didn't return it to the shelf.

I took one more slow look around the room. Then I picked up the second image-frame and stuck both it and the ceramic box inside the waistband of my shorts, where they'd be hidden beneath my loose shirt. After a final glance toward the bedroom, I pulled open the front door and exited, pausing for a second to wipe the buzzer contact and doorhandle with my sleeve.

The alley was as deserted as before, but I glanced over my shoulder more than once as I mounted my bike and rode away. After several blocks I pulled to the curb, where I peeled off my gloves and stuffed them into a trash bin.

I kept gnawing at it as I rode home, but I couldn't make any sense of Rafe's death. The smell in his hab meant that somebody had wanted information from him—though that hadn't worked out as intended. I had to assume that it was my meeting with Rafe that had triggered this assault, but I could think of only one person who could have known what I'd been seeking—and that person had already hired *me* to collect his answers. Even if he didn't completely trust me, it seemed awfully premature for Garcia Ortega to be bypassing my investigation.

Still, there's nothing like a surprise to shake information out of a client. So when I got back to my office, I took a minute to get into character before making an accusation I didn't actually believe.

Garcia Ortega answered my call wearing a plush, coffee-colored robe; half a glass of red wine sat on the small wooden table beside his armchair, condensation dripping down its stem. Given the hour, I expected annoyance, maybe sarcasm. But with a business-polite expression he said simply, "Yes?"

The contrast between his appearance and poor Rafe's made it easy to give myself over to my earlier anger. I told him, "If you want to take over this inquiry, just say so. Because I don't need this sort of crap."

He frowned. "I don't—"

"Thilosone butyrate. Whoever you sent to interrogate my lead was too dumb to air out the hab afterward. Or too panicked, once things went dry."

The frown had deepened. He paused a second. Then he said, "I thought we had an agreement."

"We—what?"

"I'm not the one who's supposed to need to ask questions here."

I studied his expression, his posture. Hovering there above my desk, he seemed as relaxed and patient as when he'd sat on the other side of it a few days earlier. He might be feigning his ignorance, but I couldn't find any evidence of that.

I gave it one last try. "Rafe Lindquist."

He shook his head. Not even a flicker of recognition.

I eased back in my chair. "My lead. A former, ah, colleague; you'll have a file. When I mentioned the Warrant, he thought maybe he'd once heard something—I was supposed to meet him tonight at his apartment to talk about

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that. Somebody else got there first."

"With thilosone butyrate."

I nodded.

His frown had returned. "So—who? And what did they learn?"

Thilosone isn't easy to acquire. But unlike other "truth serums," thilosone actually works.

"Not to worry." Even after four years, I could still picture the side effects warning. I recited it for him now. *"In the rare anaphylactoid reaction to thilosone butyrate, symptoms manifest within seconds of administration; respiratory arrest typically follows in no more than two to three minutes."*

"Lindquist is *dead?"*

"Very."

He leaned toward the camera, suddenly all brisk efficiency. "Were you seen?"

His intensity surprised me. "No. I don't think so."

He was looking off to the side, his fingers flicking through a series of quick gestures. "Lindquist . . . the alley between Glendale and San Alvarado? Number eighteen?"

"Um, yes. Second floor."

He nodded. Several more flicks and then his hands dropped back to his chair. His gaze returned to me. "All right. I've sent some people. Your name won't come up." His eyes narrowed as he appraised me for a few seconds. "I don't suppose that *you* might keep a supply of thilosone butyrate?"

My still-simmering anger flared. I drew a breath, but then forced myself to just let it out slowly through my nostrils. "If I were the one who killed Rafe Lindquist, then that's what I'd have told you. And no, I don't use thilosone. That's not how I work."

He held his stare for a moment; then his features relaxed. Either he believed me, or else he'd decided to pursue this some other time.

I added, "If your 'people' find any clues as to who did kill Rafe . . ."

He gave me a little nod. "Guesses?"

I shook my head. "Nobody but Rafe knew I was coming. Nobody but you knew why."

He laced his fingers together, tapped his thumbs against each other. "Odd, isn't it?" His attention drifted away for a moment, then he asked, "You didn't find anything in his apartment?"

"No." The pair of objects still hidden inside my waistband pressed uncomfortably against my skin. Should they lead to anything, I'd tell Garcia Ortega then. Though I didn't think he'd had anything to do with Rafe's death, for now I wasn't about to put anyone else at risk.

He sighed. "Let's keep in closer touch, yes?" He turned and reached for his wineglass, lifted it from the table.

I was about to say good-bye when he leaned toward me and said, "Ms. Dalmas, please—" He glanced toward where I should have been wearing a holster, then met my eyes. "—be careful."

"Always," I said.

Thick, dark blue curtains hung beside my bedroom window. Not for privacy—the window was no more transparent than the one in my office. I'd neglected to pull those curtains shut when I'd crawled into bed; now I woke to a glare that pierced my eyelids like tornado-driven sand. And also to a stiff neck.

I disentangled myself from the sheets and sat up, trying to stretch the kinks from my neck. Eyes still closed, I watched a dream image retreat: sun-bleached sand spreading down to a sparkling green ocean, foaming waves lapping against dozens of long, still forms—bodies?

The memory of the previous evening returned. My eyes snapped open, and for a moment I just sat staring at a loose thread dangling from one curtain's tight weave. Then I lifted my pillow to regard the image-frame and the gray box I'd stashed beneath it the night before.

I got myself up and dressed. The two items I'd taken from Rafe's apartment in one hand and a mug of coffee in the other, I used my elbow to open the door

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into my office.

At my desk, I ran a finger over the university crest atop the box, its cold ceramic scroll and shield so familiar. Then I opened the box and lifted out its data crystal—Rafe's dissertation.

His advisor's name was on the third page. Matthew Johnson. I gave it a minute, but the name triggered nothing for me. My desk, though, had Johnson's complete bio assembled in a few seconds.

Emeritus professor of zoology. Long publication list—he seemed to have studied every animal native to our corner of the planet. Never married, no registered offspring. For years he'd lived alone in his own outback research station. No political history. No arrests.

There were plenty of pictures. In one he stood in the desert beside a folding table bearing three blue eggs; I searched, unsuccessfully, for Rafe's face among the ragged crowd in the background.

It was one hell of a lead. "Somebody by a campfire," Rafe had said. That could be anybody—another student on a field trip years ago, maybe, or a lover on a weekend getaway last month.

But you can only follow the leads you've got. I set up two spider-searches, one centered on Professor Matthew Johnson and the other on the uprising, and told the desk to keep enlarging those two webs until they intersected or until each reached four degrees of separation—go any wider and your searches will have linked pretty much every person and event in colonial history.

Sipping coffee, I tried some searches on my own. But if Johnson had any connections to the uprising, they weren't overt. He'd been working at his station in the outback for more than a month before the first marches and demonstrations; he was still there weeks after everything was over.

The desk chimed with a text message. I gestured it open in a pane off to the side of my work.

We have to talk. 572 Spring Street, 619. Noon.

Frowning over my coffee mug, I looked for the sender. But the message had been neatly anonymized; the desk couldn't track it back beyond the nearest public trunk line—and when it comes to tracking messages, my desk knows some rather fancy tricks.

Another chime and an equally untraceable addendum:

Sorry about Lindquist.

Very slowly and carefully, I set my mug onto the desk. Then I checked the time and asked for the interurban trolley schedule.

Hunched, downward-gazing office workers crowded midtown's sidewalks, rushing to squeeze errands into their lunch hours. As I watched them impatiently—but carefully—dodge sauntering, leisure-class shoppers, I thought of Brownian motion and wondered whether there might exist some algebraic function capable of mapping trajectories from the microscopic domain onto the pedestrian.

Not that microscopic particles typically moved with such attentive wariness. For more than a year I'd avoided entering the city; now I had to acclimate anew to the leery vigilance of the majority of its inhabitants.

The reminders had begun at the departure terminal. As I passed the beat-up metal lockers where my fellow passengers were busily depositing their guns, a policeman—his big, black holster prominent against his broad khaki hip—swaggered across the tiled floor to ask my reasons for traveling to the city. Halfway through my spurious explanation he stepped forward and frisked me, with rather excessive thoroughness. Without thinking I glared at him and opened my mouth to complain.

He squinted in surprised anticipation.

Belatedly catching myself, I shut my mouth and stared at my boots. He grunted—in disappointment, I suppose, or maybe in disgust—and gave me a shove

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toward the train car.

As I boarded and found a vacant seat whose cushions were still mostly intact, the other passengers avoided my gaze. But then, they avoided *everyone's* gaze. Even after the trolley left the terminal, all eyes remained focused on their reading or on the dusty rocks and shrubs passing beyond the train's sand-scoured windows. Nobody but me so much as glanced at the lens protruding from high on the car's far wall.

As I stepped off the train another policeman, leaning against an ornamental pillar, studied me. I stumbled, glanced away. When I looked back, though, his attention had drifted elsewhere.

A kilometer and a half from the terminal, Spring Street was a pair of facing rows of steel-and-glass low-rises. I'd visited a few times myself, back when this district was still being developed. Some of the gleam had gone out of the thick-walled buildings in the decades since then, their street-level storefronts having devolved from bistros and boutiques to shops offering work clothes or prospecting services. The ground floor of number 572 had been split between a pharmacy and a sandwich shop—the young man behind the latter's counter eyed me as I passed through to find the elevators. As I waited for the doors to open, I tried to decide whether to find his attention flattering or worrisome.

The worn carpet of the sixth-floor hallway led me past a series of identical doors bearing content-free signs like *Ecotrex Services* and *Fairhaven Development*. But there was no sign on suite 619. No buzzer, either. I knocked, waited, then tried the handle. It wasn't locked.

The empty room smelled of new paint; I tried to imagine the sort of tenant who would choose pastel pink for their walls. Opposite me, a pair of large windows framed the sixth-floor facade of the building across the street, its awnings tinted slightly blue by the windows' reflective coating. On the wall above the windows, a shiny camera-mount hung unoccupied, its wires dangling.

I took a quick tour of the empty offices off each side of the main room. Then I leaned against a window to look down to the sidewalk below. After I'd spent a couple of minutes studying the heads of passersby, the hallway door opened.

A tall, young man entered, his wavy red hair falling almost to his shoulders. He closed the door behind him, then turned to me and said quietly, "Thank you for coming."

I didn't say anything. I just stared at his face. And eighteen years into the past.

Four individuals had inspired, nurtured, and led the uprising: Kushner, Mathews, Patchell, and Vargas. David Kushner's flamboyant charisma drew and ignited the crowds. Juan Mathews's deep knowledge of history, plus his debating skills, won over the uncertain. Zoe Patchell was a natural planner and organizer—and a peerless instructor in the arts of short-circuiting locks and hacking databases.

But if those three were the heart, head, and hands of the uprising, then Luis Vargas was its soul. He couldn't outshout or out-argue an opponent, nor disable an antagonist's microphone. But when Luis Vargas brushed the ever-present lock of wavy red hair from his eyes and opened his mouth to speak, the room always quieted—because he spoke with an intense sincerity and passion that no one, not even his enemies, had ever questioned.

So now I was more than a little bewildered suddenly to be facing Luis Vargas, looking even younger than when I'd last seen him: when he had stood sobbing in the center of the stadium, forced to watch each of the twenty-nine methodical executions that preceded his own.

The young man before me waited a few seconds, then said, "I'm his brother. Daniel."

"Huh," I said.

He smiled—and memories of that gen-

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tle smile drew my thoughts from the final stadium to earlier rallies.

He said, "When my brother's body was returned to my parents, they had a tissue sample taken. From which I was grown."

Ah. Well, under the circumstances I supposed that the Central Committee might indeed have granted the Vargas family an exemption from the colony's Genetic Diversity laws.

Nodding, I said, "Succinctly explained. Not the first time you've had to, I'm guessing?"

His smile deepened. "The past couple years, more and more people have been staring at my face." He shrugged. "I'm thinking of printing explanation cards to hand out. Or maybe wearing a little sign." He mimed a small rectangle dangling from his neck. "What do you think?"

What I thought was that after my initial shock he had put me at ease remarkably quickly. Not bad for, what, a seventeen year old? "You're pretty funny. Your . . . brother—he wasn't known for his sense of humor."

Another shrug. "I've heard that. But maybe he reserved it. For certain people, or certain occasions."

Having met Luis a couple of times, I really didn't think so. But there was a quiet intensity when Daniel spoke of his "brother" that made me reluctant to disillusion him.

Then I recalled the message that had brought me here, and disillusionment was the least I wished him. I asked, "How about *murdering his own followers*—do you suppose that was another thing that he *reserved?*"

At my sudden vehemence, Daniel took a step back, bumping into the wall. "It wasn't me who—" He paused, his lips pressed together. "Look, I'm sorry about your friend. We didn't—" Again he stopped himself. He glanced downward for a second, then back to me. "Hypersensitivity to thilosone butyrate, it's only supposed to affect one person in half a million. There are barely a hundred thousand of us on this whole planet! What were the odds that Lindquist would be affected?"

This was probably not the best question he might have asked me.

"The *odds?!* You idiot! Try taking a basic course in probability sometime! And maybe genetics—that one per half-million number was based on *Earth* populations. But *we* started with a gene pool of only ten thousand people. Nobody has the slightest idea what percentage of us will react badly to *any* seldom-used Earth drug!"

His eyes had grown very wide at my outburst, and by now he had flattened himself against the wall. His hair clashed badly with the pink paint.

Time to press my advantage. "Who are you working for? What did you want with Rafe Lindquist?"

"That's what I invited you here to talk about! I wanted to bring you in from the beginning. I told her that we needed to trust you, that we should be working with you."

I held up a hand. "You told *who?*"

"Carla. The head of my cell."

I shook my head. "What?"

"The underground resistance. You have to rejoin us—it's your work that we're finishing."

Oh no. "I don't have any *work.*"

He stepped away from the wall. "You gave up when my brother and the rest were killed. But you still want the same things now that you did then."

Ice climbed my spine. "No. I really don't."

He took another step toward me. "We know about the Warrant. If *we* can recover it; we'll finally be able to push through some changes. You have to help us."

My mouth had gone dry; my heart raced. "No! What are you talking about? There's no *resistance!* How could there be? Everyone was killed!"

"You weren't."

"Me? I'm nobody. Just another face at

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some rallies."

"Carla says that some of your people didn't give up. That they went underground and started forming cells. Building up resources, biding their time."

"This Carla is lying to you! How big is this resistance supposed to be? How many members have you actually met?"

He smiled—that smile. "I've only met the members of my own cell, of course: Carla and—" His expression softened, to a look of trusting vulnerability that I'd forgotten, a look that begged me to not let him down. "—and now you."

He had gotten very close. Now suddenly he reached out and gripped both of my shoulders, tight enough to hurt. He said, "You're not alone anymore."

I shoved him away. He staggered back, nearly falling.

"You're not Luis! You're just some kid—some kid who's been listening to a lot of croc shit about a mythical resistance movement! You need to wake up, and soon, before you go too far. I should turn you in now, for your own good."

He shrugged. "For croc shit, you have to admit it's pretty high quality. Like, how did I find out about the Warrant? About you? Who listened to you talking to Rafe Lindquist? Where did the thilosone come from? How did I learn about this vacant suite?"

"I don't know! Your Carla must have some good contacts—that doesn't add up to a *resistance.*"

With a sigh, he said, "She told me that you'd be like this. That nobody from the uprising ever wants to believe us when we first contact them. All right . . ." He pulled his phone from a pocket, held it at chest level. The display lit a few centimeters above the phone; from my position I could see the wrong side of several lines of text. Studying them, he said, "Among your closest friends from the uprising, your nickname was Bender. This nickname was given to you by Fiona Halpern on the second day of the uprising, after the two of you—"

"What the—?" I lunged forward and grabbed the phone from his hand. I scrolled through the rest, which continued for a few pages. It was all quite accurate, some of it a bit intimate—and none of it known to more than a few people. It was also far too personal and trivial to have been extracted and recorded during any official interrogation.

I looked up to glare at him. "Who gave you all this?"

He shrugged. "It was passed to us from another cell. I assume a former associate. . . ?"

"Yeah, sure." I tried to figure out how he'd really gotten the information.

Damn. More mysteries.

Unless, of course, there actually *was* a resistance.

Damn.

I tossed the phone back to him. "I don't have time for this." I walked around him to the door. My shoulder, where earlier he had gripped me so tightly, twinged now when I reached for the handle.

He said, "I'll message you an encryption for contacting me."

I turned to face him. "Maybe I'll just hand that over to the authorities."

"You won't."

His damn smile was starting to annoy me.

I said, "Look, just stay out of my way from now on, all right?" I turned. Then, over my shoulder, I said, "And Daniel? Try not to kill anyone else, okay?"

His smile faded. I pulled open the door and left.

As soon as I got back to Hab Town I consulted a few maps, transferred a few hundred rips into my phone, and threw together a small overnight bag. I checked the results of the searches I'd set up in the morning: my desk hadn't turned up any connections between Johnson and the uprising. I pondered that for a few minutes, then shrugged—it wasn't like I had any other leads to be following just now.

I biked across town to a certain vehi-

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cle dealer.

"Ms. Dalmas!" On seeing me step through his door, Demetrios Balbani nearly vaulted over his desk to greet me. I braced myself for one of his customary bear hugs, but at the last moment he must have seen me flinch; he stopped and reached out a huge, hairy hand.

While he gave my arm several vigorous pumps, I asked, "How's the family, Demetri?"

He waved me to a chair, leaned his own bulk against his desk. "Good, all good. Stavros graduates next month—can you believe it? Getting him out of that mess, Ms. Dalmas, for that I can never repay you." Then he grinned, deep within the black underbrush of his beard, and pointed a thick finger at me. "Though today you're going to give me another opportunity to try, am I right?"

I acknowledged his deduction with a sheepish smile. "Have you ever considered a career in private investigation?"

His laughter was like a baritone sonic boom. "What, finding what someone is seeking? Figuring out when a person is lying to me? So what do you think I do here all day?" He shook his head, then suddenly he strode to the door and peered out toward where I'd parked. "That little bike still behaving for you? New power cell holding up?" He turned back into the room; before I could reply he continued, "But now you're ready for something *bigger*, am I right?"

"Oh, definitely," I said. "But just a rental, for a couple days. A rover."

His eyebrows lifted. "And where would you be going that requires a rover?"

I shook my head. "Better you don't know. In case certain people somehow trace me this far."

"Oh-ho." He looked impressed.

"No special supplies or anything—I'll just be spending a night or two, indoors."

He waggled his finger at me and looked stern. "You don't drive into the outback without supplies." He held up a hand to stop any arguments from me. Then he returned to his desk and gave it a tap. "Sal, bring around the BR-20, will you?" Facing me again, he said, "Nothing flashy. Top speed is only around a hundred, but she can take a real beating. Sleeps four, almost comfortably. Plenty of room for gear. The power cells are fresh, and—" He pointed his finger at me. "—there's water and food for at least three days. We keep it prepped for the weekend hunters."

He led me outside. Next to my bike a very large, very orange vehicle now sat grumbling to itself.

"Somehow," I said, "I was expecting something a little more . . . well, brown."

"You buy your own rover, you get whatever color you want. For the weekenders all I care is that a rescue copter can find them."

Demetri led me on an inspection tour. The boxy, slope-sided body rode high on four massive tires; in a windstorm, he explained, the tires could be deflated to leave the body hugging the ground. In addition to the storage spaces in the passenger compartment, exterior access panels on both sides opened to additional cargo holds. As promised, some of these were packed with containers of water and camping food.

We clambered into the air-conditioned cab and he reviewed the basic controls. "The rest," he concluded, "you can learn while you drive."

I nodded. "So what's this costing me?"

He snorted. "Please. But maybe you'll come to Stavros's graduation?"

"Are you kidding? I wouldn't miss it—even if I need a rescue copter to get there."

His laugh boomed. When it ebbed, though, he seemed uncharacteristically subdued.

"What?" I asked.

His head tipped one way, then the other. Finally, frowning, he said, "Stavros—he's a smart kid. He wants to go to the university. So I'm the bad guy."

"What, because of where you were

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born?"

He looked away. "Maybe I could've saved more money. Asked some of my city contacts for a recommendation . . ."

I shook my head. "Even if you'd been allowed to move into the city, the Committee would never have let your children attend the university. That's reserved for the wealthiest, most powerful families."

I regretted the words as soon as they escaped. Demetri was too polite to do more than shoot me an appraising glance. But within my mind suddenly streamed the vivid impressions of an excited young woman being delivered to the university by her haughty parents. I scowled at the memory's intrusion. That was someone else's life, not mine. That young woman's life—prospects, parents, and all—had ended eighteen years ago.

"Hey—" Demetri slapped the arm of his chair, jolting my attention back to the present. "You meant what you said before, about somebody trying to trace you?"

I appreciated his shift of topic. "Yes."

He nodded. "Wait here." He climbed out of the rover.

I watched through the windows as he walked around the vehicle and opened one of the cargo holds. Then he reached for my bike; with one hand he lifted it and slung it inside.

I opened my window as he slammed shut the access panel. He called up to me, "One less clue for the bad guys! Am I right?"

"Demetri, you are *always* right."

He stood there grinning, his finger leveled in my direction. As I sealed the window and waved good-bye, I jotted a mental note to have a talk with Stavros about bad guys and good guys.

It took me half an hour to reach the north edge of town. For a minute I peered out at the flat, dusty landscape, crisscrossed by innumerable tire and tread tracks. Matthew Johnson's research station sat in a valley about seven hours to the northwest. So, to be safely paranoid, I pointed the rover northeast and told it to drive in a straight line until further notice.

I launched the driver's tutorial and began studying command options and emergency procedures. Every few minutes I glanced at the rearview display.

After about an hour I shut down the tutorial and told the rover to stop. For ten more minutes I scanned the desert to my rear. No one followed me.

So I entered the coordinates of the outpost "town" of Glendora, and instructed the rover to head there at a moderate speed. The rover estimated the trip at five hours, which would get me in just a bit before dark. After a night's sleep, that would leave me an easy three-hour drive to Johnson's station the next morning.

The rover didn't need my help to adjust for terrain or to steer around obstacles, so I got out of my seat to explore my coach.

Behind the pair of front seats, four swiveling, reclinable chairs formed a roomy oval. Next came a short passageway, kitchenette on one side and bathroom on the other. This opened into the remaining space, as large as the forward seating area; most of it would usually be used for storing a hunting party's gear. A pair of tables folded down from the walls, their accompanying chairs stowed behind a panel. I checked the remaining wall lockers—most were empty, but one held an impressive first-aid kit; another contained additional water and food. Next to the rover's rear hatch, a final panel opened to reveal a rack holding a pair of rifles.

I dislike guns of any kind, but living in Hab Town engenders a certain level of familiarity. These were high-powered hunting rifles, complete with night-vision sights and multispectral rangefinders. Not the latest models, but they looked reliable enough. According to their displays, both rifles were fully charged and loaded.

Without touching the guns, I carefully closed the panel.

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Back in the driver's seat, the view hadn't changed much—gray-brown bare dirt, scattered scraggly bushes, the occasional hill or shallow valley. Ahead, near the horizon, I thought I saw something moving. Focusing the rover's forward camera gave me a blurry view of a large reddish blob and two smaller ones, ambling away from me with bouncy gaits. The display's caption suggested they might be a family of ceratopsids, probably hunting for forage.

I considered my own hunt. Suppose that Johnson had somehow gotten hold of the Warrant—he could have hidden it anywhere in the outback. Simply go for a long drive, dig a hole, and record the coordinates. Had Garcia Ortega's people already dealt with such possibilities?

I pulled out my phone, told it to link to the crystal that rested inside the scanner in my pocket. After a minute I found a file titled "Aerial Searches." Yes—apparently the same sort of frequency-shift probe that Garcia Ortega's crystal could generate would also work, with a strong enough radio beam, from blimps, helicopters, or even satellites. Over the years, the Subcommittee on External Affairs had searched a very wide region indeed—both urban and rural, and more than once.

Of course, a simple metal cage could block a radiowave. So they had also tried various particle beams capable of penetrating such a shield. And still failed to detect any shifted echoes.

The Subcommittee, true to bureaucratic form, had included in its report an estimate of the medical effects of all those particle beams passing through bystanders. Its conclusion—"approximately 350 new cancers, leading to perhaps thirty deaths"—was presented without apology or justification. A telling indication of the attitude toward the rest of us held by our self-appointed rulers.

My employers.

I tried to push that thought away, as I'd long ago learned to do. But, I found myself thinking, what if there really were a resistance movement? And what if it actually had a droplet's chance in the desert of succeeding?

No. For me to picture an imaginary moment of hypothetical success would require me first to peer back at the all-too-real minutes and hours of actual failure. And those images lay behind a door that I refused to reopen.

I looked out over my empty surroundings. The ceratopsids had disappeared beyond the horizon. Complex shadows, already noticeably longer than earlier, extended toward me from each wirewisp bush we approached. The rover's suspended cabin floated in serene ignorance of the terrain's dips and rises.

For almost four more hours today, and then until midday tomorrow, I would be riding outside the world of Subcommittees, Warrants, and resistances; powerless to cause or prevent the turnings of history, the deaths of patriots or fools.

I rubbed a sore spot on my shoulder as I let that thought sink in. Then, after one more inspection of the rearview display, I gestured my phone to bring up a recent article I'd downloaded from the university's net. I scrolled to *For $m > 3$, assume not,* and settled back into my seat.

The metropolis of Glendora boasted a small hotel, a grocery and supplies shop, a dry cleaner, a gunsmith, and, of course, a water station. I parked the rover before the first of these and climbed down to the unpaved ground. A halfhearted breeze swirled the dust at my feet; above, a line of high clouds flamed in an amethyst sky.

The hotel—about the size of two back-to-back habs—lacked a formal entrance. One of the doors facing the street was labeled "Manager." I buzzed; after a long pause the door was opened by an overweight man in his late twenties or early thirties. He wore only a pair of khaki shorts, their top unfastened to accommodate his belly. His eyes drooped under pale blond lashes; matching fuzz covered his scalp, face, torso, and legs.

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On seeing me, his initially defensive expression brightened considerably. "Oh!" He peered past me toward my rover, then returned his attention my way with a gap-toothed smile. "Welcome to Glendora! Please, come in, come in!" His voice was surprisingly high pitched.

Great—the stereotypical lonesome outback washout. In another minute, if I gave him any conversational openings, he'd be pouring out his heart to me about his unfortunate life.

He stepped back to let me enter. The hotel's air-conditioning wasn't even up to Hab Town standards—his apartment was noticeably hotter than the cooling evening outside, its air sweetened with greasy cooking odors. His desk faced a side wall; currently floating above it was a flat image frozen from what must have been some ancient Earth movie—a familiar-looking man in a fedora gesturing with a cigarette toward a woman in dark slacks and a white blouse, everything black and white.

He noticed my gaze. As I placed the actor's face—Bogart, of course—he asked, "Are you a fan too? Of the classics?"

"No," I said. "Jenna Dalmas. Got a room?"

"Um, sure. Of course. I'm Roger. *Dalmas*—what is that, Irish?"

"Not anymore. So one night probably, possibly two. I do have a request."

His eyelids fluttered as he caught up with the conversation. "A request?"

"I'd rather not register and pay until I check out." I had no real reason to believe that my account was being traced, either by Garcia Ortega or by Daniel's alleged resistance—but my paranoia level remained elevated. "That won't be a problem, will it?"

He looked completely bewildered, as if I'd asked him for a cigarette. Or a fedora.

I continued, "I know it's a little unusual. So I'll be happy to give you a deposit up front. How about, say, a hundred rips? You could hold it in your personal account, rather than the hotel's."

I waited a moment for him to work that out. Then he gave a slow nod. "Sure. No problem, Ms. Dalmas."

He stepped over to his desk, pushed Bogart to the side, and brought up a fresh pane. He made a few gestures, then looked expectantly my way.

I took out my phone and made a few gestures of my own. A branching chain of innocuous-looking personal messages rippled through a great many public and private nets, each encoding a covert I.O.U. from one person's very unofficial account to the next. After a couple of seconds, one hundred of those ripples converged untraceably into Roger's desk; he grunted happily and closed his pane. Then he slid open a desk drawer and dug through its contents until, with a magician's flourish, he pulled out a blue and white card. He tossed the card onto the desktop, then spent a minute gesturing his way through a new series of panes.

Over his shoulder, he said to me, "Normally we just key the door to your phone, when you register." He closed his last pane, then turned and presented me the card. "Room three," he said. "Around back. I can bring you dinner once you're settled in."

"Thanks, but I've got my own food." I turned toward the door.

"Later, if you'd like to watch a movie or something . . ."

I paused, then turned back to give him a smile. "Thanks, Roger. I appreciate the offer. But I'm really pretty tired."

"Oh, sure, of course. Maybe another time."

I smiled at him some more. It was the least I could do. "Good-night, Roger."

"Good-night, Ms. Dalmas. Oh—Ms. Dalmas?"

I'd already grasped the door handle. "Uh-huh?"

"I'm supposed to ask what you're here for. Hunting, probably, right?"

"Yes, that's right," I said. "Hunting."

I imagine the pounding on my door

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had been going on for quite some time. I'm not a light sleeper under any circumstances, and especially not only a few hours after stripping off my clothes and flinging my travel-tired body onto a bed.

"All right!" I shouted into the pitch-black room. "Hang on."

I reached down to the floor where I'd left my phone. The display's glow, when I touched the contact, dazzled. One o'-clock. Great.

The pounding resumed. It no longer sounded like someone's fist—I was guessing something igneous.

"Yeah, okay!"

I felt around on the floor until I found my shirt. While I donned that I stood, continuing my explorations with one foot. The chill of an unexpected belt buckle made me yelp. I grabbed my shorts, tugged them on as I headed to the door.

"Okay, what—?" I yanked open the door, revealing a startled Daniel Vargas. The rock in his raised hand glistened darkly in the dim light of Glendora's municipal streetlight.

"Hi," he said. "Sorry to—"

He was eased to one side by the person who'd been standing behind him. She was a little shorter than me, a lot thinner, and a good deal more awake.

"Ms. Dalmas," said the woman, "we need to talk. My name is Carla."

I was too disoriented to reply, or to prevent her from pushing past me into my room, followed by Daniel. One of them turned on the overhead light. Squinting against the sudden brilliance, I shut the door by feel.

As my eyes adjusted, Carla smoothed the bed's rumpled covers, then sat herself in the center of the mattress. Daniel leaned against the room's small desk; he pushed its flimsy steel chair toward me. I ignored it.

"How the hell—"

Carla dismissed my concerns with a wave of her hand. "You already know," she said, "who we represent. You seem to be on your way to retrieve a certain object. We're going with you."

I glared at her. I guessed her age at thirty, maybe thirty-five. She wore her black hair very short; slate-gray eyes looked out from a delicate-featured face. A slight smile suggested amusement at some secret joke—but that smile, like the rest of her, was hard and angular.

I said, "You seem to know a great deal about me, *Carla*. Even things I'm not aware of—as far as I know, it's a bit premature for any talk of 'retrieving.' And at the moment I'm really not looking for any chaperones."

She leaned back against the wall, studying me.

Daniel, meanwhile, was staring at the floor, his seventeen-year-old gaze glued to the undergarments I hadn't bothered to slip into. He caught me observing him; with a blush he straightened up and turned his attention to the opposite wall.

"You know," said Carla, "we're not your enemy. You need to work together with us on this."

"What I need is some sleep. The rest we can discuss tomorrow."

She seemed about to say something else, but suddenly she stood. "Fine. In the morning, then." She marched across the room and exited. Daniel—with a few furtive glances toward various regions of my person—filed after her.

Damn! How had they managed to track me here?

I waited a couple of minutes, then eased the door open. Through the gap between the hotel and the neighboring building, the town's streetlight illuminated a wide wedge of dusty ground, empty except for a few small bushes and the scattered jagged remnants of an old steel shipping container. Still barefoot, I stepped carefully around the building's perimeter.

A second rover—tan and newer than mine—was parked centimeters behind my own. As I watched, the light within its windows dimmed.

No need for them to stay awake to keep watch. With their rover right be-

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hind mine and the hotel in front, there wasn't space enough for me to pull out.

I returned to my room, furiously reviewing the events of the previous day. Where had I slipped up, what breadcrumbs had I inadvertently trailed behind me? As I paced, I massaged my sore shoulder.

The shoulder that Daniel, yesterday, had gripped so tightly.

I yanked off my shirt and lifted my arm so I could scrutinize the side of my shoulder. Among my various moles and freckles, none particularly stood out. Running my finger over the area, though, I felt what could have been a tiny scab on my upper arm. I grabbed my shirt from the floor and turned the sleeve inside out—a minute red-brown stain marked the fabric.

More angry with myself than Daniel, I pulled out my scanner. Setting it to display a wide spectrum of radio frequencies, I held it near my arm and waited. For a minute the various amplitudes wavered up and down—normal communications chatter. Then, for just an instant, there was a sudden spike.

I narrowed the frequency range and turned the sensitivity way down. A minute later, the spike recurred. I dialed the sensitivity even lower, and over the next few minutes confirmed my suspicion—periodic signal bursts were emanating from my upper arm.

I stood there, unable to think about anything but my fury at Daniel and Carla, at myself, at this whole idiotic quest. After a minute, though, the fury gave way to extreme frustration. Which, being essentially my baseline emotional state for the past two decades, freed me to turn my attention to my immediate problems.

I wasn't actually as trapped here in Glendora as Carla assumed. But there was no point in sneaking away while her tracker remained in my arm.

I rummaged through my overnight bag for my multitool. I carried it into the tiny bathroom, where I spread a towel across the sink to work over. I folded out the smallest knife blade, and then—holding my breath—I drew the blade's tip across my arm.

I'd barely scratched the skin.

I took a new breath and tried again, this time pressing a lot harder. The sudden pain made me gasp; blood began welling from the cut.

I probed with the knife—to my surprise, despite the pain and blood, the incision was still only a couple of millimeters deep. But the tracker would probably have been injected more than a centimeter beneath my skin. So I clenched my jaw and jabbed the knife farther into my muscle, first at one angle and then another. Blood streamed down my arm, soaking into an enlarging disk on the initially off-white towel. Finally—as I was starting to grow concerned about the amount of blood a person could lose before fainting—the knife tip scraped against something hard and smooth.

I paused for several seconds to catch my breath.

I dug the hole deeper around my apparent target, working by feel through the upwelling blood. My arm felt as if a lizard with narrow, powerful jaws had taken a big chomp and now refused to release its grip. Each movement of the blade sent an aching shudder up and down my arm; cold sweat coated my body.

I grabbed a thin washcloth and twisted it around my arm, trying to staunch the bleeding for a minute as I lowered my head and waited for my gasping breaths to ease.

Then I unwrapped the washcloth and used it to wipe off the knife blade. I folded that blade back into the multitool, in exchange for a pair of small needle-nosed pliers.

The pain when I pushed the pliers into my arm almost made me throw up. It took a few tries to get a good grip on the slippery object, but finally I managed to extract the tracker—a ceramic needle, no more than a millimeter or two in di-

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ameter, maybe five or six in length. I let it drop onto the bloody towel.

I applied another washcloth as a bandage, securing it with a fresh towel tied as tightly as I could manage using only one hand and my teeth. Then I retrieved my scanner and spent a few minutes confirming that the needle, and not my arm, was now the sole source of radio spikes in the room.

I placed the needle carefully into the trash, then wadded up the blood-soaked towel and washcloth and tossed them onto the floor of the shower. I sponged the blood off my arm and torso, along with some of the sweat. Then I returned to the main room and got myself properly dressed.

According to my phone, dawn was still several hours away. I hoisted my bag, took one last look around the room, switched off the light, and started to open the door. Then it occurred to me to close the door to the bathroom—for a second I considered also leaving the faucet running, but I just couldn't bring myself to waste so much water—hoping that the closed door might buy me an extra minute or two when Carla and Daniel came knocking in the morning.

I crept to my rover as quietly as I could. I paused to listen for any sounds from the other vehicle, but apart from the warm breeze rustling the dry branches of a nearby bush, the night was silent.

I unlocked the door and climbed in. There were no signs that anyone had been here since I'd left. I moved to the back of the rover and got out the first-aid kit. After replacing my makeshift bandage with something a bit more reliable and a lot less bulky, I gave myself an antibiotic injection to cover any bacteria my amateur surgery might have stirred up. The kit also held injectors for pain; reluctantly, though, I decided that using those might leave me too doped up to carry out my plans for the rest of the night. A shiny emergency blanket caught my attention; I jammed it into my overnight bag.

I turned toward the rear hatch. Several seconds passed before I could make myself open the panel and take out one of the rifles. I double-checked its charge and ammunition, ran the control system through a self-diagnostic.

Back in the driver's seat, I loaded my phone with local maps. Then, carrying my bag and the rifle, I exited and locked the rover.

The cover of the external cargo hold squeaked as I eased it open. It took me a couple of minutes to lift my bike out without making too much noise; by the time I was done, my bandaged arm ached badly enough that I thought about returning for the pain injectors.

I relatched the cargo hold. From another hold I removed a few water pouches. I crammed those into one of the bike's two panniers; my overnight bag fit into the other. The rifle I lashed to the bike's crossbar with some tape I'd borrowed from the first-aid kit. With one last glance at the other rover, still crouching silent and dark, I slowly pushed my bike down the street, keeping to the edge of the road and to whatever shadows I could find.

After several minutes I reached the terminus of the streetlight's illumination. Glendora remained asleep and still, apart from one quick scurry by some small animal crossing the road back by the hotel. Before me the desert extended into blackness beneath an overcast, starless sky.

I got onto the bike and flipped on the headlight. Then I started the motor and put a spray of dust between me and the town of Glendora.

After the first half hour my adrenaline subsided. Racing ever forward into the headlight's unchanging wedge of illumination, unable to hear anything beyond the bike's low hum and the rush of air past my ears, I fell into a sleep-deprived trance broken only by the occasional sharp scents of night-blooming plants—and by moments of heart-racing panic

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when a boulder or drop-off suddenly darted toward me from the darkness. Every fifteen or twenty minutes I woke enough to pull out my phone to check my position and course.

About two hours from Glendora, my eyes were jerked open by violent bouncing and shaking. The ground was scattered with jagged rocks, from pebbles to shards the size of fists. Disoriented, I braked hard—and the bike immediately slewed sideways into a skid. I struggled to stay upright, holding the throttle partway open as my rear wheel danced across the broken surface. For an instant the tire regained traction—but then it slipped back into the skid. Despite my efforts, the bike tilted closer and closer to the rocks speeding past. Then the rear tire caught hold again. The bike spurted forward just long enough and just upright enough for me to release the throttle and brake both wheels.

In the end, I still dumped the bike. But not until I'd come nearly to a stop.

In the abrupt quiet I lay on my back across the broken rocks, the bike's handlebars pinning my legs, its headlight shining skyward. Both wheels spun lazily. I shut off the motor, then lifted the handlebars to release myself. I turned the light toward the nearby ground.

My arm—my *good* arm—had been scraped up quite a bit, and one leg was bloody with shallow scratches. But I seemed to be basically intact. And the bike, apart from a few dents, looked undamaged, too.

Even with all the pebbles and rocks, lying down felt remarkably good. I thought about resuming my journey but couldn't muster a convincing argument. If I didn't catch a few hours of sleep, my next accident could easily turn out much worse. Besides, to avoid overrunning my headlight I'd been keeping my speed down all night—I could make much better time if I waited for daylight before continuing.

I left the bike on its side—no harm in keeping a literal low profile out here—and pulled my bag from the pannier to serve as a pillow. Under the overcast sky, the unmoving air still held some of the day's heat; wrapped in the emergency blanket, I figured I could manage to sleep. I pushed rocks aside and adjusted my position until I was reasonably comfortable, then flipped off the headlight.

And became blind. Without stars or city glow, there was simply no light anywhere. Maybe a miner or farmer wouldn't have cared—but I was a town dweller, and for me the impenetrable blackness was foreign and frightening.

I shut my eyes tight, trying to pretend that beyond my lids lay a world of streetlamps and light switches. And that I had to keep my eyes shut because . . . ah! Because someone was watching me. Someone I had to convince that I was sleeping.

This proved to be a less inspired pretense than I initially thought. Soon I found myself listening intently for evidence of my supposed observer. Tiny, indistinct sounds in the distance amplified themselves under the focus of my attention, until finally my too-long-awake brain grew sure that some large, stealthy creature was creeping toward me. I opened my eyes—and panicked at the complete darkness. I flailed for the headlight switch.

Once the light spilled across the rocks, my panic quickly subsided, leaving me feeling rather stupid. But I'm not one to deny the existence of her inner idiot—if I were going to catch any sleep at all tonight, clearly it was going to take something more concretely reassuring than an imaginary observer.

I unwrapped the tape holding the hunting rifle to my bike. After spending a few minutes making sure I was familiar with the gun's basic control menus, I reached over and turned off the headlight.

Hugging the rifle with both arms, this time I did finally fall asleep, the rifle's display pulsing pale blue like some guardian fairy.

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I'm not sure which sound woke me—one of the high-pitched tremolo shrieks, or the basso rumbling growl. The night was still opaquely dark when my eyes snapped open. But the urgent animal cries, though clear, sounded safely distant.

I folded out the rifle's display and set the scope to night vision. Holding the gun in shooting position, I rose onto one knee and aimed.

About two hundred meters from me, the two creatures poised in the display's monochromatic pseudo-daylight looked unevenly matched. The larger, according to the scope's estimate, stood nearly three meters tall. Its tail lashed angrily as it retreated on its four stamping feet, both pairs of its fore-claws scything downward at its opponent. That opponent's squat body stretched barely two meters long, though half of that length seemed to be snapping jaws.

The short one's growl surged as it launched itself through the air—its brown stripes clear in my mind, if not in the night-vision display—and took a huge bite from the other's belly. The tall creature let out a final shriek, then stood unmoving for a few seconds before collapsing boneless to the ground. The croc waddled in and began a vigorous meal.

The savage brevity of the encounter left me shuddering. Panic returned then, and I hoisted the rifle and pivoted in a quick circle—followed by a second, more careful one—peering into the display for any glimpse of additional predators.

Reassured, for the moment, that the night held no threats other than the distant croc, I resumed my previous pose. The animal still dined; its repast, I guessed, would continue for some time yet. I assumed the croc would then lurch off to its lair—soon, I hoped, before the arrival of dawn. With any luck I wasn't camped on the route to that lair.

I kept watch for half an hour, my tiredness forgotten each time those great jaws yanked out another ragged morsel. Finally the croc lay still for a few minutes. Then it lumbered up onto its several feet. I held my breath, waiting to see in which direction it would set off.

But the croc just stood there. Then it began waggling its snout from side to side. After several seconds of this, it stopped and remained still for another moment. And then it turned and looked directly into my scope.

I gasped, nearly dropping the rifle. Fumbling in the dark, I disabled the safety and activated the autosight. Several very long, very bad seconds elapsed before I could find the croc again. When its pale image reappeared in the display, the croc was taking careful, deliberate steps straight toward me.

I tried to steady my arm against my knee, tried to calm my trembling with a slow, deep breath. I'd have to aim manually—red icons at the edge of the display indicated that the croc was out of range for ultrasonic targeting and wasn't warm enough or moving fast enough for the night-vision sight to automatically distinguish from the landscape. So, trying to recall teenage survival-training lessons, I half filled my lungs and held my breath, and eventually managed to steady the sight's laser onto the croc. The tiny dot of light danced up the animal's snout, settled just above its eyes.

Abruptly, this memory: *Leaning against the wall of a dimly lit room filled with quiet breathing and snores. My colleagues, I think sleepily. My comrades. A pale red dot is moving across the forehead of the woman slouched in a chair across from me; I wonder from where in the rotunda of City Hall such a graceful beam of red light might arise. And then there's blood and loud gunshots from all directions and screaming, and someone falling against me knocking me to the floor.*

I screamed now, I think, as I grabbed the trigger. The rifle's recoil shoved me off balance. Frantic, I pointed the rifle back into the night, peering into the display as I searched everywhere

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for the croc.

I finally found it, tens of meters farther away from me than before and rapidly increasing its distance each second. Whether it was my wild shot or my scream that had identified me, apparently noisy, armed humans didn't appeal to this particular croc.

Laying the rifle on the ground before me, I collapsed onto both knees. And began sobbing—but not out of relief.

Because I wasn't kneeling on the cracked and scattered rocks of a desert night. No, I lay stretched across a smooth, polished floor, terrified and helpless amid shrieks and falling bodies and concussive bursts of light. I lay in a room whose door, a decade and a half ago, would swing open before me every night when I tried to sleep, and every day when a loud noise or sudden flash of light caught me off guard. All these years I'd been reinforcing my barricades against that door and training myself to look away whenever I accidentally wandered near. In the past decade I had avoided all but the briefest glimpses into that room.

But now, an hour before an eighteen-years-later dawn, it was as if I'd never left City Hall. Again and again came the shouted commands, the smells of blood and excrement, the hard boot kicking my ribs. And through it all: my terror at the forces descended upon us. My helplessness to defend myself. My guilt for failing to protect my colleagues—my friends—who died when I didn't.

Sobbing, I sagged forward until my head rested against the ground.

If the Committee Police had wanted to, they could have simply fired a few shots over our heads and then marched us out at gunpoint, with no loss of life. But no, they needed to send a message to future would-be rebels. And that message was framed in the bodies of my dead comrades—the comrades I'd always pictured as courageous and powerful, but who I now recognized as young, naive idealists, with no means to defend themselves—even if someone had shouted a last-minute warning.

I dried my face on my sleeves, then picked up the rifle and scanned the night all around me. Satisfied that no new threats were creeping my way, I settled into a less uncomfortable position to await the dawn.

And only then did I realize that just now I had simply *stepped out* from the room of my nightmares. I'd never done that before. Yet if I turned to look back through that still-open doorway, the memories remained clear and immediate. I felt as much terror as always, and—huh—almost as much helplessness. But the ever-present guilt, to my surprise, I could no longer locate at all.

I sat there among the broken stones and thought about that.

After a while, violet light began spilling over the horizon's low hills, and the dry, dusty air around me stirred as if the world were drawing in the day's first hesitant breath. I retrieved one of the water pouches from the bike and sipped it as I watched low clouds slowly brighten from rust to apricot.

Soon there was enough light for me to make out a dark, irregular mound lying across the rocks about two hundred meters off. Even without the rifle's scope I could discern small movements that must have been scavengers, probing what the croc had left behind.

Which made me recall my own scavengers—who were, I hoped, only now waking in Glendora. I finished my water and picked up the gun. As I packed everything back onto the bike, I began to wish that before leaving town last night I'd thought to grab some of the rover's food packs.

Well, I'd be arriving at Matthew Johnson's research station soon enough. Maybe he'd offer me breakfast.

From the front, anyhow, the station was smaller than I'd expected—a rough-walled ceramic building no bigger than a few habs pushed together, several wire-

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fenced pens, a few sheds. A rover sat by what I took for the main entrance; I parked my bike beside it.

I couldn't find a buzzer contact, but the door was unlocked. I pushed it open and called, "Dr. Johnson?"

No one answered. I stepped inside, into a small alcove where a collection of dusty shoes and boots covered a third of the stone floor. A couple of high-collared storm coats hung from metal hooks screwed into the walls; their leather surfaces cracked from wind and time.

I walked past the coats into what was apparently the station's living room. The beige-painted walls held maybe two dozen image-frames, each showing a different group of grinning, grimy people dressed for fieldwork. I found Rafe in two of the pictures. Four comfortable-looking armchairs defined a square around a low table; the debris from someone's recent meal was stacked in the only corner of the table not scattered with data crystals. Two doorways led from the room—through one I could see a refrigerator and an oven; the other revealed only the ends of some sheet-metal shelves.

I called Johnson's name again, then repeated it louder. Finally, from the second doorway a voice—like rusty iron dragged across sandstone—called, "Well, don't just stand out there. Come into the lab!"

Wondering whether he'd taken me for someone else, I stepped around the table and chairs and through the doorway.

It was like walking into the university's biology department. Two high, stone-countered workbenches stretched away from me down the length of the brightly lit room. A row of tall shelving units and storage cabinets lined each side wall. Most surfaces held neat arrays of laboratory equipment—pipettes, probes, culture dishes, heating and cooling units, and plenty of other objects I couldn't identify. The skeletons of several small animals were on display, as were the bones of some much larger creature looming in the room's far corner.

A scent of hot sand and a sudden scuttling sound drew my attention to the wall beside me. Wire cages and glass terrariums were stacked nearly to the ceiling. Scaly animals—some as small as my thumb, others the length of my forearm—stared back at me, displaying extravagant multicolored frills and ridges, mouths full of tiny teeth, and generally too many appendages.

"I'm out of skin cement," the raspy voice said. "There's a big bottle in the blue cabinet beside you."

Wearing a lab coat of almost the same beige as the walls, he stood hunched over his workbench near the room's other end. Wire cages sat on the counter to either side of him; I couldn't see what he was working on.

"Well?" he asked, without turning from whatever he was doing. "This *helioskolex* isn't going to heal on its own!"

The cabinets along the side wall nearer me were each painted a different color. I opened the azure one and found a large glass bottle half full of purple liquid, neatly hand labeled "Skin Cement." I carried it down the aisle between the benches, set it onto the counter beside him.

Johnson still matched his old images, though his tight-curled hair had grown grayer and his skin even craggier. Lying on the bench before him was a row of metal instruments—scalpel, tweezers, scissors and such—and also a legless creature a few centimeters long, with something brown and shiny bulging from a small incision in its belly.

Without looking at me, Johnson opened the bottle and poured some of its contents into a small, wide-mouthed jar. He dipped a swab into the jar, then used that to paint the edges of his patient's cut. With tweezers he pulled the incision closed; the purple edges stuck together as if magnetized.

He lifted the creature and held it close before his eyes for a few seconds, ignoring its feeble squirms. After a satisfied grunt, he dropped it into the cage on his

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right, where it landed atop a pile of others of its kind.

The cage to his left held two more of the creatures. He reached in for his next victim, and then—still without looking my way—said, "Thanks. So who the hell are you?"

"Jenna Dalmas. I'm investigating something." I peered over his shoulder as his scalpel opened another belly. "What are you doing to these guys?"

He snorted. "Why—did their mother hire you to *investigate* me?" He finally turned his head my way. "Damn! What the hell happened to *you?*"

I glanced down at my scraped, scabbed limbs, my battered clothes. I shrugged. "Let's just say that I could use a better travel agent."

He eyed me a moment longer, then grunted and turned back to his bench. Lifting a beaker full of brown glass beads, he said, "Radio trackers." He rattled them, then plucked one out with a pair of tweezers and popped it into the animal. "Doesn't hurt a bit."

"Not going *in,* maybe."

He ignored my comment as he applied the purple cement. "Big controversy about how far from the nest these larvae get before their final molt."

"Really."

"Oh yeah." He dropped the creature into the right-hand cage. "Affects the whole ecological model."

Neither of us said anything else as he tagged the final little animal. Then he gathered up his tools and carried them to a sink at the end of the bench. He washed them with practiced efficiency, setting them out to dry on a pyramidal black wire rack. He glanced my way. "Would you count up those leftover trackers for me? Just dump 'em out on the bench."

With a shrug, I poured them out, and then pushed the beads around with both hands until they packed themselves into a rectangle. Five rows of six beads each. "Thirty," I told him.

"There's a paper beside that cage, with the number when I started. Write down your number, and then the difference."

If this was supposed to be some sort of test, it was certainly starting out easy enough. I slid his paper toward me. It bore a series of hash marks—but they were a strange mess. Here and there were the standard four vertical ticks with a slash. But more often he had put down some random number of ticks—three, eight, six—and the diagonal slashes occasionally came in pairs.

"What the hell—"

"Please," he said, his attention apparently focused on washing his hands.

So without further comments I counted up all his marks: forty-seven. I wrote down that number, then my thirty, then the difference.

He came back to where I stood, pointed at my final figure. "So that's how many helios I must have tagged?"

"Seventeen, yeah." Puzzled by his behavior, I turned to look at him. He was squinting at my calculation as if trying to confirm the steps of a complex mathematical proof. After a few seconds he shook his head and let out a heavy, disgusted breath. "Dyscalculia," he said.

"What?"

He snorted. "Calculational apraxia. Numeric dyslexia." He shook his head again, then busied himself tidying up the workbench. "Had a small stroke last year. No big deal, right? Except that out here it takes kind of a while to get medical attention. So they could only fix *most* of the damage."

I stared at him.

"Damnedest thing. In the end, just two residual problems. I can't do much with this pinky finger—" He waggled his right hand. "—and for anything involving numbers beyond *three,* I'm completely fucked." He faced me, his deep-grooved features expressionless. Then he shrugged. "All right, Jenna Dalmas, investigator. What the hell are you here for?"

His abruptness took me off guard—but I'd been ready for that query since before I'd parked my bike. "Well, two

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things, actually. Some news to tell you. And a question." I gestured back toward the living room. "Maybe we should sit down?"

His gaze was fixed on my face. "This wouldn't be good news, I don't suppose?"

"No. I'm afraid not."

He gave a little nod. "Then let's just stay right here and get this over with." He took a step back and leaned against the bench, his arms crossed over his chest.

"Right." I took a slow breath. "Do you remember Rafe Lindquist?"

That seemed to surprise him. But then he looked annoyed. "Dyscalculia, Ms. Dalmas. Not amnesia. Or dementia."

"Um . . . huh?"

"Well, I'd damned well better 'remember' Rafe, hadn't I? We've only been exchanging messages every few months for—" He paused, then frowned. "—well, for a lot of years now."

I held up a hand. "Sorry. All I knew was that he'd studied with you back in grad school."

He grunted. "So what's Rafe to you, then?"

"We knew each other, a little, back in school. And, um, afterward."

He gave me a sharp look. "In the uprising, you mean?"

Not knowing his politics, I braced as I answered, "Yes."

But he only nodded and looked thoughtful. "Can't say that I recall ever hearing your name."

"Oh, no, we were only casual acquaintances. And then we fell completely out of touch—until just a couple of days ago."

He cocked his head to one side, and his expression hardened. "What's happened?" His dried-out voice was quiet but threatening, like the first sprays of dust blowing in ahead of a windstorm.

"Rafe's dead, Dr. Johnson."

The air seemed to go out of him, and for a second I thought he might lose his balance. But after a moment he said, "Go on."

"Somebody killed him the night before last. They were trying to get some information out of him. They messed up."

He turned his face away from me.

I waited.

Finally he spoke. But what he said was, "You must have known my daughter."

I frowned. "I didn't think you had any children."

He nodded, still looking toward the nearby wall. "Her mother and I split up before she was born. We didn't register my name. But my daughter and I always stayed in touch. Right to the end, almost." He faced me again, looked me up and down. "You and Zoe must have been just about the same age."

My eyes widened. "Wait—Zoe? Not Zoe Patchell?"

His gaze tight on my face, he gave the barest of nods. "You knew her?"

"Oh yes," I said. Recalling her goofy grin one time as she looked up from some hack I'd helped her pull off. Recalling her tiny, distant figure in the stadium, her suddenly limp body collapsing to the blood-slick ground while I still cringed from the shot's echoing report. "Yes," I repeated. "We met a few times."

He nodded again, this time as if something in my response had met with his approval.

Then he shook his head. "And now Rafe. The bastards will get you all, eventually."

I shook my own head as I tried to correct him. "It wasn't the Committee who killed Rafe. In fact—"

Suddenly angry, he waved away my objection. "Haven't you figured this out by now? It's not the Committee Police that keep the Central Committee's families in power. No—it's everybody who doesn't rise up and kick the damn Committee and its doubly damned police off this planet! *That's* who killed Zoe and Rafe: everybody who hears the shots but then just looks the other way. Everybody who thinks about standing up and defying the Central Committee but then

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pushes those thoughts aside and keeps doing what they're told."

That struck a little too close to home. I wanted to tell him that you can only ask so much of people. That you can't demand that someone keep sacrificing her entire life for some abstract ideals. That sometimes people just have to survive.

But I didn't say any of those things. Because—of course—I knew he was right.

Johnson misunderstood my silence. "I know what you're thinking. That here I am making this speech, while meanwhile I'm as guilty as everybody else." He sighed. "Well, you're right. We're all guilty." He paused, and then he glanced at my face with an expression I couldn't decipher. His voice dropped. "Well, almost all of us, anyhow." And then, as I wondered just whose face he'd seen in that glance, he pulled himself up straighter and said, "Thank you, Ms. Dalmas, for traveling all the way out here to tell me about Rafe. I do appreciate it. I believe you also said that you have a question for me?"

Huh. For a minute I'd actually forgotten about that.

I tried to collect my thoughts. All of this talk about guilt and responsibility, and about Zoe, was stirring up feelings that I'd thought I'd lost a long time ago.

"I'm here because of something Rafe said. When I asked him if he'd heard any rumors about the Warrant."

A muscle jumped beside his jaw. Otherwise his face could have been stone. "The Warrant?"

"I don't suppose you'd have any idea what happened to it, after the uprising?"

Frowning, he squinted at me. "Who's your client, Ms. Dalmas? Who hired you to ask me this?"

I stared right back. "The Subcommittee on External Affairs." I wasn't going to apologize to him. I wasn't going to deny the choices I'd made.

"And they know you're here? That you're investigating me?"

"Um, no. Not exactly."

That seemed to intrigue him. "Really? You don't keep your clients informed of your progress?"

"No, not always. Not every little detail."

From above his shoulder, the skeleton of a creature with a pair of too-close eye sockets and a long, wide jaw grinned knowingly at my claim.

"I see," said Johnson. He gave me an appraising look; after a moment he apparently reached some decision. "Did you know that those people—your employers—have been out here a couple of times since the uprising? Poking around and asking vague questions?"

Damn! I should have spent more time with Garcia Ortega's data crystal. All this trouble—and Rafe's death—for an already-examined dead end.

He continued, "I guess *they* knew about my connection to Zoe. So it was the Warrant they were looking for?"

I nodded. "It disappeared during the uprising. They want it back, as you might expect."

"How about you, Ms. Dalmas? What do *you* want?"

I opened my mouth, but then realized that I had no answer for him. That simply wasn't a question I ever asked myself.

He prompted, "Do you want the Warrant in their hands? Or maybe you'd prefer that the Vulesk kick us back to Earth? Assuming they don't just kill us all, of course."

His taunting was starting to annoy me. Mostly, though, I was simply exhausted—physically from last night, and now emotionally besides.

"You know, Dr. Johnson, I don't really have a *clue* as to what I want. So how's this—you just go ahead and tell me that you have no idea where the Warrant is; then you offer me breakfast. I eat, I leave, we never see each other again. Okay?"

He glanced once more at my scrapes and scabs and gave me a rueful smile. "You've obviously gone through a lot to come visit me, Ms. Dalmas. I'd really like to tell you what you want to hear—but I'm afraid I can't. The Warrant showed

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up here the day after Zoe was murdered by the Committee Police."

If I hadn't been so tired, I suppose I would have said something clever. As it was, I just slumped against the workbench behind me.

He continued, "Parcel post. She packed it into a box and *mailed* it to me. Hand addressed; her name wasn't anywhere on the package. The note inside just said, *Can you hold this for a while?*"

"So it's been right here all along?" I looked around at the cabinets and shelves. But no, the Subcommittee had already been here, hunting. And if he'd buried it somewhere in the desert, their aerial searches should have turned it up.

He shook his head. "They had just murdered my daughter. And nobody—none of *us*—had tried to stop them. Do you think I cared whether someday the Vulesk might disband our colony—or even kill us? All I had to do was destroy the Warrant and eventually the whole colony would get exactly what we deserved."

A day ago his statement might have made me gasp. Now, though, I wondered what I would have done in his place. Maybe he was right. Maybe our colony had gone too far wrong, maybe we'd proven ourselves unworthy of this new world.

"So that's it?" I asked. "You destroyed the Warrant?"

He was slow to answer. Finally he nodded. "I may have. But my best guess is no—it will probably all still be there."

"Huh." I was too drained to even work up the annoyance to demand a straight answer.

"What do you know about salmon-lizards, Ms. Dalmas?"

I just looked at him. This was his show now. He'd been rehearsing this scene in his mind for eighteen years; I was merely the audience.

He persisted. "Really. Salmon-lizards?"

I shrugged. "Small, harmless. Grown on farms, right?"

"Come here." He turned and marched toward the end of the room where I'd entered. After a second I followed.

He pointed to a big terrarium.

At first all I could see was an empty tank, half full of dry soil. But then something moved against the glass, down inside the soil. Stepping closer, I could make out a system of tunnels. As I watched, a slim, light brown creature twice the length of my middle finger scuttled out of one tunnel and disappeared into another.

"Incredibly good at hiding from predators," he said. "Even after a couple of decades, almost all of a brood will survive to return for mating."

"Return?"

"Well, yes, that's where they get their name. They always return to their original nest to mate. The entire brood arrives within a day or two of the anniversary of their hatching. After several hours of frenzied mating, they burrow into the ground and build a communal nest."

"That's where they lay their eggs?"

"No. That's where they die. The eggs—usually just one per lizard—continue to develop within their parents' decaying bodies. When the larvae hatch, a plentiful supply of easy-to-digest nutrients surrounds them."

"Yum."

"After a few molts, the young salmon-lizards climb to the surface. Once they've rested up and gotten their bearings, they scatter in all directions, each eventually traveling impressive distances—never to meet again until it's time to mate."

"A couple of decades later?"

He nodded.

"And right now I find all this fascinating because . . . ?"

"Did you know that the Warrant is hollow? And that each of those gemstones has a hole drilled through it? They're beads, actually, strung on a complicated wire frame."

He paused, then, as if his non sequiturs should now have answered all of my questions.

It took me a few seconds to put the

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pieces together. Then I stared at him. "No," I whispered. "You didn't . . ."

He returned my gaze. "I just couldn't bring myself to destroy it. Not right away, anyhow. Maybe someday there'd be another uprising. Maybe someday there'd be people living here who didn't deserve exile or death."

"But . . . well, just how big is a brood of salmon-lizards?"

He held up his hands in a gesture of helplessness. Right—he couldn't do numbers anymore. But he said, "More lizards than beads, if that's what you're asking."

"So you took the Warrant *apart* . . . ?" I shook my head in wonder, trying to picture him—still coping with the news of Zoe's death—driving out into the desert to find a newly hatched brood of salmon-lizards preparing for their diaspora. Capturing them. Popping one of the Warrant's gems into each belly, sealing the incisions with his purple cement. And then releasing the lizards into the desert.

He said, "I recorded the disassembly, of course, so it could be reversed someday. Several of the lizards are carrying copies of that recording."

"How thorough of you," I said, dumbfounded by the insane risk he'd taken with the colony's future. But then, he'd already been prepared to condemn us all.

What about that wire frame, though? He couldn't fit *that* into a lizard. He'd have to hide it someplace safe, somewhere that—oh.

Impressed, I glanced across the room toward his workbench. Toward the pyramidal wire rack he used for drying his instruments.

He granted me a small smile. Not so much acknowledging his own cleverness, I thought, as expressing his satisfaction with me for figuring things out.

"Okay," I said slowly. "So then you just wait for the lizards to come home. A couple of decades, you said—?"

He nodded. "The exact schedule varies from one brood to the next—so the nest site has to be checked each anniversary until they show up. I've been out there a couple times so far."

"But they'll return in the next few years, right? Before the Vulesk arrive?"

He snorted. "How the hell should I know?"

"Let's hope," said a familiar female voice through the room's doorway, "that they return *very* soon."

Carla stepped into the lab, the neat little maser pistol in her hand pointing my way. Daniel entered behind her, carrying the rifle I'd left with my bike.

"Keep your eye on the Professor," she told him.

Before the stacked terrariums, Daniel took a careful stance. Holding the rifle at waist level, he aimed it toward Johnson's chest. Then, for just an instant, he glanced at me; he didn't look happy.

"Well," I said, "you two must have gotten up early."

Her mouth smiled. Her gray eyes didn't. "We'd have been here even sooner if we hadn't wasted so much time on that loser hotel manager."

"Roger? He doesn't know anything! What did you—"

For a second her smile deepened. Then she shrugged. "Nice trick you played on us." The tip of her pistol gestured toward my bandaged arm. "Must ache a bit, huh?"

I peeked at Johnson. He was staring at Carla, his expression fixed and grim. His index finger twitched every few seconds.

She said, "I should have thought of your damned motorcycle. Still, it's not like there were a lot of fresh bike tracks leading away from Glendora this morning. Or a lot of possible destinations in the direction they pointed."

I nodded toward her gun. "I thought you said you weren't my enemy."

"Things certainly would be going smoother if you'd believed me. We're a bit beyond that now, though, don't you think?"

Daniel turned toward her. "But—"

"Daniel." She spoke his name like a teacher firmly cautioning a child.

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He pressed his lips together and, after a guilty glance my way, returned his attention to Johnson.

Johnson's stony silence was making me nervous. I worried that he'd make some sudden, stupid move. So I told him, "These two have been following me for days. Carla here claims that they're from some secret underground resistance movement. And that they want the Warrant so they can force through some big political changes."

He nodded. "They the ones who killed Rafe?" he asked.

Uh-oh. Hoping that he wasn't about to try anything, I moistened my lips. "Well—"

"It was an accident!" Daniel blurted. "We—"

"Daniel!" Carla looked quite annoyed. But she still kept her eyes on me.

Their interchange hadn't perturbed Johnson's expression. Staring at Carla he said, "And now you're going to have an accident with *us."*

She seemed surprised. "Why, no—not at all! I'm simply going to ask you a few questions, and then we'll be on our way."

I didn't suppose that Johnson bought that any more than I did. I asked, "What questions?"

"We were listening to you two for several minutes, you know, from the other room. So, Professor, now all you need to tell me are the coordinates of the salmon-lizard nest and the anniversary date."

His dried-out voice was as quiet as before. "Go to hell," he told her.

Her head shook sadly. "Disappointing. Oh well. Daniel?"

He avoided my gaze as he lowered the rifle and set it against the cages. Carla stepped to one side as he walked past her toward Johnson.

She pointed her maser between us and said, sweetly, "If either of you tries anything, the other one cooks."

Daniel reached into a pocket and pulled out an injector.

"Daniel," I said, "you don't have to do this! Don't take the chance. Not again."

Frowning, he looked at me, then at Carla. Then he shook his head as if to clear it and fired the injector into the side of Johnson's neck.

Johnson gasped. His whole body tensed, and his eyes opened very wide. For a long moment he didn't move, except for a slight swaying.

Then, finally, he exhaled and relaxed.

I hadn't realized that I'd been holding my own breath. I let it out and exchanged a relieved glance with Daniel.

Reaching up to rub his neck, Johnson asked, "What—?"

"Thilosone butyrate," I told him. "Truth serum."

He faced Carla. "You're going to be sorry."

She said, "Bit late for threats, Professor."

He snorted.

Daniel retreated to Carla's side. He reached for the rifle.

"No," she said. "Get out your phone. Take down his answers." Then to Johnson she said, "All right, Professor, where do you keep the coordinates of the nest site?"

His mouth opened, but then he snapped it shut. He clenched his teeth and squeezed his eyes shut, as if fighting for control.

Carla sighed. Her gun made a small movement—

—and my left hand burned as if it were immersed in flame. I yelped and reflexively jerked my forearm to my chest.

Carla watched, dispassionate.

I held the hand out before me. Its skin had turned bright red, and blisters bulged from the backs of three fingers. I glared at Carla as I lifted my hand to blow cool air at it.

"Well, Professor?" she asked. "Or are you going to just stand there while I set her whole body on fire?"

He'd been staring at my hand. Now he met my eyes, his expression pathetic in its helplessness. He turned to Carla.

"Damn you," he said.

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She shrugged. "The coordinates?"

"I committed them to memory."

"Good for you. Well?"

He glared for another second. Then his shoulders slumped. "Fifty-four point seven three two," he said. "Fifteen point six."

Daniel jabbed at his phone.

Johnson continued, "Three point one five four."

"Wait," said Daniel. "That's too many numbers. Give it to me again."

Johnson took a breath. "Sixty-eight thousand and three. Eleven point five one seven."

"No!" Daniel looked up. "That doesn't make any sense!"

Carla was frowning. "It's also different from his first answer. The injector—"

Daniel said, "I gave him the right dose!"

Her eyes narrowed. After a few seconds she said, "Professor, tell me that we're on Earth."

"What?"

"You heard me." She pointed her gun at my face. "Say it!"

"All right, all right! We're on—" He grimaced. "We're on—"

"Professor!" Her finger shifted on the trigger.

"We're—damn it! Don't shoot her! We're *not* on Earth!"

Carla gave a puzzled nod and the pistol lowered slightly. "Okay, so the thilosone is working. But then why . . ."

I said, "He told you that you'd be sorry."

Her gaze shifted my way.

"It wasn't a threat," I explained. "I guess you showed up too late to hear about his stroke—he can't do numbers anymore." At her baffled expression, I turned to him. "Dr. Johnson, can you tell Carla what number follows fifteen?"

"Six," he answered. "No—eleven?" He frowned as the thilosone compelled him to try to come up with the truth. "Wait, you said the number after thirteen?"

"Thanks, that's good enough. Sorry." To Carla I said, "Sort of an ironic situation, huh?"

The confusion on her face changed to reluctant comprehension and then, for an instant, to fury. But then her anger faded and she looked *lost,* like an explorer who'd studied all the maps and plotted all the routes, but now found herself gazing outward from the precipice of an impossible cliff.

Daniel broke the silence. "Dr. Johnson, you must have recorded this somewhere! In what data file? Is it online? What are the passwords?"

"No passwords," he replied, looking a little smug now. "No files."

Carla gestured to Daniel; he picked up the rifle and aimed it at Johnson's chest. Her own gun continued to point my way. "Well, then, Professor, I suppose we'll all just have to try a bit harder here."

"Not necessarily," said a new voice. Through the doorway strolled Garcia Ortega, his gun aimed at Carla. To me he gave an exasperated look. "So you're always *careful,* are you?"

For a second we all stared at him. Then both Carla and Daniel suddenly recalled Johnson and me. They shifted their positions to keep us and Garcia Ortega all in view.

I said to him, "If there's anybody else lined up outside that doorway, could you ask them to come in now? I don't want to spend my entire day doing this."

He studied the scene. "You must be Daniel Vargas—I've always wondered whether someday you'd become a problem. And Dr. Johnson, of course." He gave a polite nod. Then he addressed Carla. "But you . . ." He shook his head, as if she had somehow disappointed him. He knew her?

She gave him an icy glance, then turned her attention to me. Her gun lifted slightly, as did the corners of her mouth.

Not wanting to let her retake the initiative, I blurted, "What the hell are you *doing* here?"

Carla frowned, for an instant not real-

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izing to whom I was speaking.

"Your phone," said Garcia Ortega, "has been offline since yesterday. I was worried."

"Okay, but how did—" The answer became obvious as soon as I started to ask the question. "You bastard!" Some hotshot investigator I was—based on my recent performance, the next time I needed to sneak out of town I might as well post my destination in sky writing. "Your data crystal—it programmed my scanner into a tracker."

He shrugged. "Also a microphone. So in addition to rescuing you, I've saved you the trouble of having to fill me in on your past hour's conversations."

"Gee, thanks." I held up my reddened hand. "Though your rescue might have come just a few minutes sooner."

"Will you shut *up!*" demanded Carla. By now she was looking more than a little irritated. "Both of you! You're outgunned, damn it. Shoot one of us, Jorge, and either Johnson or your girlfriend dies. This is still my play."

Garcia Ortega didn't appear particularly disturbed by either prospect. "You think so, Miriam? Even after Daniel learns what you're up to?"

The tip of Daniel's rifle twitched. But apart from a deepening of his frown and a slight narrowing of his eyes, no other visible reaction escaped.

"'Miriam'?" I asked.

Garcia Ortega nodded. "Miriam Halpern. She's an assistant to one of my subcommittee's staff members. How did you think she learned about the Warrant, and about you? And also, I suppose, about Daniel here."

Daniel's frown deepened further. He glanced at her, then at Garcia Ortega, then back to her.

I examined her face more closely than I had earlier, trying to imagine her brittle features softened by a bit more flesh. The resemblance was subtle, but . . . "You're related to Fiona Halpern," I said.

"Shut up," she said.

"You know, Fiona once told me about her little sister. Her sister idolized her, Fiona said. She'd even convinced Fiona to give her access to Fiona's diary, so she'd always know what Fiona was doing and thinking."

Miriam's thin lips tightened. Her gun hand extended toward me.

"Steady . . ." cautioned Garcia Ortega.

I kept my voice soft and even. "So I'm a little surprised that you'd be working for the Central Committee. Considering how, in the City Hall raid, the Committee Police put four bullets through your sister's head."

The threat of Garcia Ortega's gun kept her from broiling me with her maser. But not from giving me a look so cold that I wouldn't have been surprised if Johnson's lizards beside me had suddenly evolved fur.

Daniel said, "So that's why you joined the underground! To avenge your sister's death."

She held her glare on my face as she answered him. "Don't be an idiot."

Daniel's injured expression suggested that he wasn't accustomed to Miriam addressing him so harshly.

She continued, "You can't avenge yourself on a system, Daniel. Or change one. Fiona tried that—she's dead. No, all there is in this life is what you can get for *yourself.*"

"But . . . what about the Warrant?"

Miriam didn't answer, so I decided to help him out. "Cash, Daniel. Anonymous ransom notes. A carefully arranged money drop. Lots and lots of cash."

I hadn't seen such a miserable, disillusioned face since . . . well, since I'd witnessed his brother Luis listening to the cheer rise from a stadium of his fellow citizens upon the execution of his comrades.

In a constricted whisper, as if he'd just been punched in the stomach, Daniel asked, "And the resistance?"

Still facing me, Miriam rolled her eyes.

Garcia Ortega remained alert, his gaze twitching between Daniel and Miriam. For the moment, though, apparently he

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was leaving the conversation to me.

"A fairy tale," I told Daniel. "Dreamed up to pull your—our—strings."

Daniel shook his head. His fingers, one of them wrapped around the rifle's trigger, clenched and unclenched in a way that made me very nervous.

"No." His voice grew louder as his conviction firmed. "Carla, everything you told me, everything you believe—you couldn't have been making that up! Not all of it!"

"Daniel," she said, "just shut up." She pointed her maser straight into my eye. "And you—"

We had all forgotten Johnson. This whole time he must have been very slowly easing his hand into his lab coat, until it had reached the holster on his belt. Now he yanked out his gun and swung on Miriam.

The movement drew Daniel's attention; the barrel of his rifle jerked toward Johnson's chest.

"No!" I shouted.

Garcia Ortega's gun fired nearly simultaneously with Daniel's.

Daniel let out a loud gasp, then slowly folded at the waist.

I threw myself full length onto the concrete floor as Miriam's maser sizzled and Garcia Ortega's gun barked again. My body curled in on itself, eyes squeezed tightly shut. My heart hammered—I needed air, but a rigid band gripped my ribs. "No," I whispered. "No no no—"

Hot liquid sprayed across my cheek and something hard crashed down onto my burnt fingers. My hand shrieked with pain; louder, more terrible shrieks echoed in my mind.

The pain drove my eyes open. Johnson's gun lay on the floor by my hand, his arm outstretched and unmoving beyond it. I pivoted my head to look up. Miriam, facing away from me, was the only one still standing.

Miriam's maser angled downward, toward the doorway against which Garcia Ortega now sprawled. I imagined a red dot sliding across his forehead.

And suddenly I was filled with rage. *No!* Not this time. Not again.

I lunged forward into a rolling dive over Johnson's arm, scooping up his gun with my good hand. Miriam spun at the sound—Johnson's sleeve burst into flame and heat scorched my calves. My roll carried me up onto my knees; I aimed and shot Miriam in the thigh.

She screamed and grabbed her leg. Behind her, Garcia Ortega's gun sounded once more. Miriam's body slammed against the end of one of the lab benches, slid to the floor. She moaned for a few seconds, then let out one long, last breath.

She lay facing me, her gray eyes staring in disappointed surprise. Her delicate features didn't look quite so hard or angular now.

Behind me, a wet cough. I twisted around to examine Johnson. His sleeve still smoldered—the fabric's gray smoke spread into the room with an acrid scent that partly masked the smells of fired ammunition and singed hair and burnt flesh. The front of Johnson's coat was all blood; I forced myself to focus on his ash-gray face.

He noticed me watching him. His gaze locked intensely onto my face; he tried to say something, but couldn't manage it. He lifted his unburned arm and pointed upward, past me.

He was pointing at the underside of the lab bench's stone counter. I leaned toward it and looked closely, but there was nothing there. Puzzled, I turned again to Johnson. His arm had dropped back to the floor. He was no longer breathing.

Numb, I used my good hand to push myself up to a crouch and then to standing. The backs of my calves stung as I straightened my legs.

Daniel was unconscious, but breathing slow and steady.

Garcia Ortega had managed to sit himself up against the doorframe. The left side of his face was bright red and hugely

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swollen; his left arm lay in his lap, charred. His breaths came in deep, wheezing gasps as his right eye followed my movements.

Somewhere during the excitement my phone had gotten smashed. I staggered out of the lab into the living room. There was probably a radio or a phone tucked away in there somewhere, but a quick survey didn't turn it up. I continued through the alcove and outside.

The harsh sun stung my burnt hand and legs. I squinted. Miriam's rover sat beside my bike and Johnson's vehicle. On the dusty ground behind them sat a two-seater helicopter.

The copter was too small to carry the three of us back to town. But Garcia Ortega hadn't locked down the controls; I was able to radio for an air ambulance. Half an hour, they told me.

I found Johnson's first-aid kit in the kitchen. An oxygen mask seemed to ease Garcia Ortega's breathing—though I had to prop the mask on his chest, rather than pulling its straps across his seared face. A pain injector seemed to help, too.

I stretched Daniel out on his back, using a couple of cushions from the living-room armchairs to elevate his legs. Besides the spot on his back where Garcia Ortega's bullet had entered, I didn't see much blood, and his breathing didn't sound labored. I covered him with one of the storm coats from the front alcove.

Sitting on a ceramic stool, I leaned against the lab bench and watched over the two of them while I contemplated the disaster I'd made of this job. Rafe and Johnson dead, Daniel unconscious, Garcia Ortega—my client—seriously injured. I actually had managed to locate the Warrant—but I'd also virtually guaranteed that it would never be recovered. No doubt Garcia Ortega would arrange a continuous watch for salmon-lizard orgies, but the desert was a very big place, the lizards were small and well camouflaged, and his people would get only a few hours to spot each gathering.

One way or another, five years from now it was quite unlikely that I'd still be living in this colony.

Did I really want to spend those final five years continuing in my current career?

I knew the career I'd always *wanted* to pursue. All these years I'd done my best to stay current, but I knew how rusty my math skills had become. Still, how about offering some informal tutoring? Plenty of Hab Town residents would welcome a chance at a bit of university-level instruction. Teaching would help me ease myself back into the game—eventually I might even make some minor contribution in the years remaining. Of course, for a license to teach I'd need somebody to pull a few strings for me—maybe I could talk Garcia Ortega into a favor.

That's what I was mulling when the medics arrived. As they fussed over Daniel and Garcia Ortega, I studied the body of Miriam Halpern. Under the circumstances I couldn't bring myself to feel very bad about her death. Still, who knew how she might have turned out if her sister had never been shot at City Hall? Which got me thinking about Fiona—and for once I was able to recall some of the good times the two of us had shared.

But I lost my smile when I turned and saw Johnson. Damn. I wished that I'd met him a long time ago, that we'd had more time together.

Then I remembered his final gesture, pointing toward the bottom of the lab bench. And for an instant all of my thoughts and emotions stopped.

The medics and their patients weren't paying any attention to me. As casually as I could, I walked down the aisle between the two lab benches until I came to Johnson's station. Pretending to examine a nearby skeleton, I ran my hand along the underside of the counter. Nothing but rough stone. I took a step to one side and continued my search. After a few seconds my fingers brushed the edge of a small piece of paper. I worked it free of its adhesive, and then gave it a quick

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glance as I pushed it into a pocket of my shorts: the paper bore two short rows of numbers, plus a date.

Apparently Johnson hadn't completely trusted his memory, even before his stroke.

I returned to the other end of the room, giving Johnson's pyramidal drying rack a little tap with my finger as I passed by. The medics were getting ready to wheel their charges out to the ambulance; one of them took a moment to dress my burned hand and apply ointment to some of my cuts and scrapes.

From what Johnson had told me, I figured there was a significant chance that the salmon-lizards would return in less than five years. That they'd bring with them enough of the Warrant's gems that the device could be reassembled seemed possible, though certainly not guaranteed. Combine those probabilities and then require the reconstituted Warrant to actually function after such abuse, and I guessed the overall chances of success as slightly better than the odds of a snowball fight breaking out tomorrow in Hab Town.

In other words, the colony's likelihood of surviving beyond the next five years had just shot up by a huge factor.

Assuming that somebody decided to meet the salmon-lizards.

I declined a ride in the ambulance. Before they left, the ambulance pilot helped me confirm that Miriam's rover would respond to my commands. He also helped me load my bike into the rover; I planned to return to Glendora and check on Roger and then take Demetri's rover home. After that I expected days of interrogation and reams of virtual paperwork from the Committee Police, unless Garcia Ortega recovered quickly enough to get me off the hook.

In the meantime, I didn't plan to wait here until the police showed up. Before I left, though, there were a couple of tasks remaining for me in the lab.

I gave Miriam's body one last look, then turned to view the stains and medical debris that marked the positions of Garcia Ortega and Daniel. Demetri's rifle lay where Daniel had dropped it; the police wouldn't appreciate me taking it back, so I figured I owed Demetri a new gun.

I removed my scanner from my pocket, then plucked out Garcia Ortega's crystal and dropped it onto one of the stone counters. Just to be safe, I pulled the power cell from the scanner before returning it to my pocket.

Finally I faced the other body. I had to clear my throat a couple of times before I could speak. "Okay, Dr. Johnson. Today somebody's *not* going to look the other way. Satisfied?" I stood by him for another minute or two.

Then I fetched what I'd come for and headed back outside.

As I waited for the rover's air-conditioning to do its job, I looked around the interior for a good hiding place. It took me a minute to see it; I grinned then, because Johnson would have approved. I lifted the lid from the rover's trash bin and pushed aside the top layer of torn food wrappers and empty water pouches. The wire pyramid fit with room to spare. I left it half uncovered.

After easing around Garcia Ortega's 'copter, I told the rover to head for Glendora. For a long while I watched Johnson's research station shrink in the rearview display.

I hoped that Roger was all right; it would be handy to have somebody I could trust here in the outback. I shook my head at myself then, as I realized that part of my mind had already begun assembling a *team*. Roger out here. Tamiko, with her schemes and contacts. Possibly Demetri. Hell, there might even be a place for Daniel.

I shook my head again. Jenna Dalmas: math instructor on weekday afternoons, on weekends the clandestine leader of the Second Uprising.

What were the odds of *that?* ■

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THE REFERENCE LIBRARY Tom Easton

Fleet of Worlds, Larry Niven and Edward M. Lerner, Tor, $24.95, 301 pp. (ISBN: 0-7653-1825-3).

The Aftermath, Ben Bova, Tor, $24.95, 396 pp. (ISBN: 0-7653-0414-7).

HARM, Brian W. Aldiss, Ballantine Del Rey, $21.95, 229 pp. (ISBN: 978-0-345-49671-3).

The Phantom's Phantom, Robert Reginald, Wildside, $15.00, 124 pp. (ISBN: 0-8095-6217-0).

KOP, Warren Hammond, Tor, $24.95, 333 pp. (ISBN: 0-765-31272-7).

A Nameless Witch, A. Lee Martinez, Tor, $24.95, 320 pp. (ISBN: 0-7653-1868-7).

Harvest of Changelings, Warren Rochelle, Golden Gryphon, $24.95, 314 pp. (ISBN: 978-1-930846-46-3).

Futures from Nature, Henry Gee, ed., Tor, $24.95, 320 pp. (ISBN: 0-7653-1805-9).

Among Larry Niven's remarkable creations one must count the Puppeteers, two-headed herd beasts so cowardly that only their insane, such as the famous Nessus, dare to treat with humans. Their leaders are called Hindmost because they lead from behind (not really so unlike humans), and they *always* bet from paranoia. **Fleet of Worlds,** set some two hundred years before the time of *Ringworld,* gives us the first close look at Puppeteer society, and it's disturbing. In 2197, the human starship *Long Pass* spots a frozen world under acceleration. It hails it and is soon boarded by a swarm of robots. In 2650, we see the Fleet of Worlds, the Puppeteer homeworld Hearth surrounded by a rosette of five farmworlds, all under power as a unit, fleeing the catastrophic supernova burst at the heart of the galaxy. One of those farmworlds bears human Colonists descended from the crew and stored embryos of *Long Pass,* supposedly rescued from disaster. Nessus has lobbied to use Colonists as scouts, seeking dangers in the fleet's path and is now on a mission with three of the best candidate scouts, pilot Kirsten, captain Omar, and engineer Eric. They are investigating a frozen moon much like Europa, where the native Gw'oth have emerged from the watery depths onto the surface to start building a technological civilization. They are impressive, for they are inventing at a furious pace and no one has given them a thing, as the Puppeteers have given the Colonists. Puppeteer paranoia becomes clear when Nessus has his charges install a powerful reactionless drive in a comet; it is capable of either (as explained) causing a close fly-by of the Gw'oth world to see how they respond, or a world-destroying impact that would remove potential dangers to the fleet.

Of course, if there are survivors, they will be some PO'd! That's the trouble with final solutions. If they aren't quite final, they can create worse problems than they solve. Using Colonists as scouts has a similar side effect. Before, they were confined to the farm, quite lit-

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erally, for they served the Puppeteers as producers of food. Now Kirsten, Omar, and Eric have had their perspectives broadened, and as the old song says, that's when it gets hard to keep 'em down on the farm. Kirsten in particular starts hunting for details about their history, and she quickly finds signs of a massive cover-up of the truth. But she's not about to give up.

Meanwhile, Nessus is dispatched back to human space to do something about the search for the Puppeteers. They had made humans dependent on their General Products spaceship hulls, and when they mysteriously abandoned Known Space, the economic impact was disastrous. Nessus's mission is to somehow divert human attention and thereby win the affections of the opposition leader, Nike, with whom he is smitten. Nike is an elegant fellow a bit bemused by the scruffy Nessus, but as he deals with Puppeteer politics, Nessus starts looking pretty good.

And Kirsten is making so much progress that whole apple carts are about to be upset. As we have long expected from Niven, it's a great read, and Lerner—as *Analog* readers know—has the knack as well. You'll enjoy this one.

Is **The Aftermath** the last in Ben Bova's Asteroid Wars series? You just can't say, for Bova has a habit of leaving enough loose ends around to justify whole new trilogies and this is no exception. You should recall that the Asteroid Wars began with *The Precipice* (serialized here) and *The Rock Rats*. Pancho Lane, jet-jockey, succeeded to the chairmanship of a major rocket shop, the Astro Corporation, and moved humanity out to the Belt, where the rock rats could extract ores for an Earth wracked by the aftermath of climate disaster. Villain Martin Humphries then plotted a scheme to take over the Belt, using a killer to scare off the independents. In *The Silent War* (reviewed here in October 2004), Lane, fighting Humphries, began to look pretty villainous herself. In the end, a mysterious alien artifact inside an asteroid scared the heck out of Humphries and changed his pet killer into a redemption-seeking holy man, Dorn.

Before Dorn became Dorn, however, he was Dorik Harbin and among his misdeeds was the destruction of the rock rats' Ceres-orbiting habitat, *Chrysalis,* shortly followed by the near-destruction of the ore-transport *Syracuse,* crewed by Victor Zacharias, his wife Pauline, and his son Theo and daughter Angela. *Aftermath* begins with these events. Victor tries to decoy Harbin away from his ship by launching himself in an escape pod. He apparently succeeds, but at the cost of being stuck in space, running out of air, and with no way to get anywhere. Fortunately, he gets picked up by a rather predatory babe who would rather keep him than help him rescue his family, left behind in a hulk without communications or fuel.

Fortunately, teen Theo is able to pull his act together and make enough repairs to keep everyone alive and on an orbit that will bring them back to Ceres. Eventually. Like years later.

Meanwhile, Dorn and his aged artist friend Elverda Apacheta are hunting for bodies left over from the war while being hunted by Humphries' killer ships. And pirates who pretend to be salvagers are hunting for anything they can find. In due time everything comes together, lots of mustachios get twirled (some not very convincingly), and Humphries' cloned son, Alex, steps onto the stage.

What will happen next? The people seem to have settled down, but the nature of the alien artifact remains unresolved, and I think Bova may find it difficult to leave that alone, especially since it may mean a grand opportunity to move his saga out of the solar system.

Brian W. Aldiss says he is not trying to be topical in **HARM**, but he does an excellent and disturbing job of it. Paul Fad-

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hil Abbas Ali is a born British citizen, child of immigrants, and a Muslim. He is enamored enough with the British culture to write a comic novel in which there is a throwaway line about assassinating the Prime Minister. Promptly arrested by the Hostile Activities Research Ministry (HARM), he is interrogated, beaten, tormented with recordings of his Irish wife screaming in pain, and otherwise abused. Where is he? His tormentors say Syria and Uzbekistan; all he knows is that his cell was once part of a grand house. His present plight—torture by "civilized" people, the possibility of extraordinary rendition, the bigotry aimed at his Muslim roots—echoes the faded glories of that house with the faded glories of Western civilization. The inmates have taken charge of the asylum.

Or have they? Paul can claim a touch of multiple personality disorder, so perhaps he should be an inmate. But he's hardly in charge! Except . . . He finds himself waking as Fremant to an alternate reality in which a foundering Earth has sent off a starship loaded with the coded minds and bodies of colonists. On arrival at Stygia, the coding process proves imperfect, with the result that everyone is a little dazey, at least partly because the various identities got a bit mixed into each other. Supposedly this means that the kinds of ethnic, religious, and political differences that have caused so much trouble on Earth no longer exist. Some writers might then say that people being people, they waste no time reinventing enough differences to make life hell for each other. Aldiss suggests the need for a seed crystal and sets the colonists to exterminating the local sentients, called Doglovers or Dogovers because they are always to be found with insectoid doglike creatures. Why? When Fremant eventually comes to protest, urging that humans recognize and admit their collective guilt, his fellow colonists insist it's kill or be killed, all done now and best forgotten, and then they beat him.

Bigotry and denial as the two keys to reality? Back on Earth, Paul is still being beaten etc., even after a chief interrogator announces that he is just a fool, not a terrorist or conspirator, and should be released. And of course the breakdown of society is hardly confined to the scene of the interrogations. There *are* terrorists out there, even if Paul is not one, and they *are* conspiring to do awful things. If they manage to assassinate the Prime Minister, will Paul be blamed? Will politicians seize the pretext to turn fascist?

If Aldiss did not intend to offer commentary on current events, he still did an excellent job of it. I hope that his forecast of the future—the death of all Western ideals, including freedom, tolerance, fairness, respect, and so on—is wrong, but I am afraid that there are forces at work in the world that may make that hope futile.

Back in the day—in fact, so far back in the day that not many folks alive today were reading or even alive—the pulps were born. The category included the early SF magazines, but also a host of novel series whose quality helped make "pulp" a derogatory term. One of those series was "The Phantom Detective" of the 1930s and 1940s, whose hard-boiled hero, Richard Van Loan, blew away thousands of villains with no regard for their right to a fair trial, or for the feelings of their survivors. You can find reprint issues of *Fangs of Murder, Tycoon of Crime,* and *Stones of Satan* at Wildside. You can also find **The Phantom's Phantom,** Robert Reginald's loving attempt to give Van Loan a conscience. It opens with murder in a restaurant, and the Phantom starts getting notes that say, "I know who you are, what you do, when you die." A friend dies, and Van Loan goes to California to investigate. He finds echoes of his past, but also a future in which he is a much more human being, as well as a more effective

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and modern crime-fighter.

The book is short, but the style fits the antique model, while the plot and characterization make the tale much more appealing to the modern reader.

Warren Hammond's **KOP** is either a noir fantasy of corrupt cops or a realistic variation on what can happen in a developing nation. Lagarto is a colony world that had a thriving export business until other worlds figured out how to grow the plants on which it was based. The result was instant poverty for most of Lagarto's citizens, although those who had gotten rich before the crash were still rich. So, a few haves, hordes of have-nots, and the port, the space station, and the tourist businesses were all owned by offworlders. Not surprisingly, organized crime is busy, and as the tale opens, Juno, a cop, once an enforcer for his chief, is collecting protection money from local businesses. Juno's a tough guy who had never had any trouble roughing up the uncooperative for money or information, but now he's old, he's got the shakes, and his wife wants him to lay off the rough stuff. But the chief, Paul, says he needs his help one more time. Here's a nasty murder case to solve, he says, and it's all part of the mayor's plot to bring him down.

Juno's not too sure about the conspiracy, but as he and his rooky partner, Maggie, collect clues, things begin to look nasty. Paul and Juno became corrupt in the first place by making a deal with the local crime lord to keep things under some sort of control. Now that crime lord is dead, his son is ineffectual, and the competition is moving in with grand schemes, including opening up the slave trade with Lagarto's excess have-nots. Is the mayor involved? All I'll say is that the connections reach high, and the end involves a fair amount of mayhem and blood.

But the cover gives you a pretty strong hint that Juno survives. After all, Hammond's next novel will be *Ex-KOP*.

* * *

A. Lee Martinez demonstrated a considerable talent for dark fantasy with a cockamamie twist in *Gil's All-Fright Diner* (reviewed here in November 2005), and she's at it again. **A Nameless Witch** starts off by positing that a child is cursed: Nasty Larry, as he died, condemned the sixth child in every generation of his slayer's line to be a gruesome abomination that shuns the light and dwells in miserable darkness. So a girl is born, she's undead at birth, and her folks pitch her unnamed into the dank, dark basement until she's eighteen, when Ghastly Edna shows up to claim her. Once she's out in the light, it turns out she's gorgeous, which perturbs Edna a bit, but never mind. A bit of mud on the complexion, a few dowdy and tattered robes over the rest, and a pointed black hat to top it off, and the kid will do for a witch. At least once Edna has trained her a bit, not long after which a couple of goons show up, murder Edna, and promptly die under the fond attentions of Edna's (now the kid's) familiar, the demon duck Newt.

Vengeance is the next item on the agenda, so the kid, Newt, and the enchanted broom Penelope hit the road. Soon they acquire a troll, Gwurm, and arrive at Fort Stalwart, a rather primitive outpost still under construction. She sets up as the local witch, makes a couple of friends, and discovers that she thinks men are tasty. Literally. Yum! Must resist! That's when Wyst of the West, White Knight, armored in magic, Defender of the Weak, Destroyer of the Foul, Sworn Champion of Decency, and Avowed Foe of Evil, shows up. He looks pretty tasty too, in both ways, and she is promptly smitten. But she must resist, while he, of course, is really out of reach. Isn't he? Besides being yummy he is also sworn to chastity and virtue. He also brings word of a horde of ravenous goblings heading toward Fort Stalwart.

Naturally, the nameless witch plays a crucial role in defeating the horde and

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learning that the goblings aren't really real. They are convincing fakes whose mastermind must be precisely the villain on whom she seeks vengeance. So off they all go, seeking the villain while she tries to resist the lure of Wyst of the West, who is beginning to act a bit smitten himself. How does it turn out? No, not that "it." Or that too. Whatever. There's a pair of dramatic tensions to resolve, and I won't tell you what happens. You, of course, being Astute Readers, are entitled to make guesses.

This one's good fun. Enjoy it!

Warren Rochelle's **Harvest of Changelings** is a pleasure to read, even though the basic shape of the tale is predictable from the very start. Rochelle is a careful writer with a gift for making almost all his characters come alive, and the reader roots for the good guys and condemns the bad guys with a will.

Begin with the enticing opening line: "Once upon a time there was a man who fell in love with a fairy. . . ." He's Ben Tyson, widower and librarian in North Carolina. She's Valeria, his neighbor, and when she seems to dematerialize and vanish and fly, he is intrigued. They wind up marrying, and when she is pregnant, she warns him that she must leave once the boy is born. She is needed at home, where her people are fighting a war against the Fomorii, and she is the Prime Mover, head of the ruling council, the Dodecagon. Alas, when she leaves, the Fomorii are waiting for her, all red-eyed and black and wielding fiery whips. She dies on Ben's doorstep, and he is left to raise his son Malachi alone.

A few years later, Malachi is coming into his powers as only an adolescent can. He's a misfit in school—he's small and looks funny—so the temptation to be a bit pranky is irresistible. And it turns out he is not alone. There are three other misfit children also awakening to their changeling status, Russell, Hazel, and Jeff. There is also Thomas, son of Ben's best friend, drawn to black magic, gaining power through human sacrifice, coveting Malachi because his blood will make him lord over all (except for the Fomorii lurking in the shadows behind him) and enabling him to control the gate between Earth and Faery.

There's a deadline, of course. The kids must find the gate and use it on Halloween Eve, Samhain. Thomas must seize control by then. Meanwhile dragons are seen in the skies, strange things are happening, and the federal government has quarantined North Carolina whence all the evil seems to flow. (He does not include Jesse Helms, but . . .)

Why all the fuss? Back in Faery, the Dodecagon has issued a call for all changelings—both those born of human-fairy couples and those whose fairy genes (derived from long-past crosses) are strong—to return to Faery, which won the war with the Fomorii but was weakened and needs new blood. The Fomorii are scheming to revive the war and this time win; indeed one of their leaders remarks on how sweet fairy souls will taste.

So there's a lot at stake, and it all comes down to a final hell-ride in a church van driven by a changeling priest. At this point even a reader who thinks it's all predictable is on the edge of his or her seat.

Great fun, well done, and Rochelle deserves loads of fans.

In 1999, the weekly science journal *Nature* started running "Futures," short (two - three page) science fiction stories as attempts to glimpse possible futures. The feature lasted a bit more than a year and then picked up again in 2005 and ran till the end of 2006. Contributors included Arthur C. Clarke, Brian Aldiss, Stephen Baxter, Cory Doctorow, Jack McDevitt, Charles Stross, Bruce Sterling, and far too many more to list here. The anthology **Futures from Nature** includes a full hundred, most of

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which are readable and even delectable. And the stories are just the right length for those brief interludes with which life abounds.

It also provides a nice answer for the perennial question of what sample of SF to give someone who thinks of SF as puerile c**p, perhaps because of excessive exposure to much of what passes for SF in Hollywood. These stories don't come from a pulp magazine with lurid covers, nor even the more well behaved modern incarnation of such a magazine. They come from a highly respectable *science* journal (Hey, *Nature* published the Watson & Crick paper that spelled out the structure of DNA and won a Nobel Prize). Therefore, QED, *this* SF is highly respectable too!

It won't a hurt a bit that the stories are good as well. I enjoyed them. ■

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BRASS TACKS

Dear Stan,

Until I read the July/August 2007 *Analog*, I considered Michael Flynn second only to Heinlein as a hard SF author (using "hard" here to mean "reality-based" rather than "difficult"), and second only to DeCamp as a competent and intriguing explicator of science-fact.

His Latin-titled double-header, in the July/August issue, forces me to re-evaluate this. The fictional half of the set ("Quaestiones Super Caelo et Mundo") easily equals the best that RAH ever wrote—the factual item ("De Revolutione Scientiarum in 'Media Tempestas'") handily beats out DeCamp's best (and also most similar) factual work, "The Ancient Engineers."

Flynn's double-header not only makes clear that the so-called "Dark Ages" created more enlightenment than chronologically parochial moderns tend to imagine, it also raises (for me, at least) a question which I hope he will address in subsequent fiction and/or non-fiction:

If modern science arose directly from "Dark Ages" (medieval western Europe) philosophical premises and ways of thinking, then how can we ensure that our culture will hang on to science, now that our culture has grown beyond (or otherwise abandoned) many of the premises and ways of thinking which (Flynn cogently argues) the scientific revolution depended on?

Example: Flynn makes a pretty convincing argument that, if medieval western Europeans had not believed in a single absolute god who lays down immutable and universally absolute laws, medieval western Europeans would have had a tough time coming to the notion that "laws of nature" could exist, could deserve study, and could reward such study. (Today, fewer and fewer of us believe in a single absolute divine law-giver: many who disbelieve this, in fact, disbelieve it for reasons grounded in that very science which, Flynn argues, required monotheism in order to arise.)

Similarly, Flynn's list of cultural obstacles to science (that prevailed in cultures outside medieval Western Europe) includes (1) a belief in "a multitude of self-willed gods" and (2) a belief that "all possibilities must eventually come to be" somewhere/somewhen in the universe or universes. Regarding (1)—polytheism has notoriously made a comeback (among well-read, college educated under-40s in the USA, at least: including—to my personal knowledge—quite a few *Analog* readers, computer programmers, and others whom one would generally regard as scientifically inclined. Regarding (2)—judging from what little I understand of current developments in physics, at least one widely supported interpretation of available data on particle behavior (the "multiple universes" interpretation) does hold, quite as strongly as any believer in cosmic cycles, that all possibilities must eventually exist—do indeed exist—somewhere out there.

Now let's imagine that, sometime in the not-too-distant future, rigorous scientific experiment establishes the "multiple-universes" interpretation as factually correct. (Heck, we could even imagine that, sometime in the not-too-distant future, rigorous scientific experiment establishes *polytheism* as factually correct!)

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Let's imagine that, sooner or later, these experimental findings become generally known. Perhaps it turns out that consequences of these findings make a difference: just as findings on evolution make a difference in medicine because modern medical research depends in very large part on consequences of evolutionary biology (as another excellent July/August story pointed out: C. W. Johnson's "Political Science," which I wish that someone could make required reading for every holder of a government office).

And let's imagine, too, that Flynn has it right: that a polytheistic culture (or an all-possibilities-come-true culture) tends not to grow scientists. (Note to my polytheist friends who read and write for *Analog:* I don't *know* that Flynn has it right.) So . . . If science ever really does establish the reality of (say) multiple universes where all possibilities come true—and if Flynn has it right about this sort of belief discouraging science—then science educators (including science popularizers) will have a heartbreaking choice.

Making the scientific findings a part of the culture (which science educators and popularizers strive to do) means making the culture less able to grow scientists (if "multiple universes" proves true, and if Flynn has it right about the mental effects of believing that all possibilities come true). Keeping science in a culture requires (among other things) ensuring that the culture keeps on producing scientists.

Let A = "the set of beliefs that make it harder to think and act like a scientist" . . . let B = "the set of important scientifically established findings" . . . then suppose that, as Set B becomes bigger and bigger through scientific discoveries, Set A and Set B begin to overlap. Presumably, if and when this ever happens, learning about scientific findings tends to discourage (rather than encourage) potential future scientists.

So—*if* Flynn has it right (and if the "multiple universe" physicists turn out to have it right, too), then some particular phenomenon "out there" will (once discovered and understood and accepted as true) impede scientific thinking in the people who understand/accept that phenomenon. If this happens, then sooner or later:

(a) we have fewer and fewer people going into science (because their cultural background includes the scientifically discovered obstacle to scientific thinking),

and/or

(b) we have people going into science, but dropping out or losing interest once their science education reaches the "overlap" area and they have to absorb (as part of their science instruction) an impediment to scientific thought,

and/or

(c) people going into the sciences produce less scientific work than previous generations of scientists (take "less scientific work" either in the sense of "a smaller quantity of scientific work" or in the sense of "work that less deserves the name of science.")

Once this happens (and it will happen, if both Flynn's reasoning and the multiple universe hypothesis prove true), some science popularizer(s) or other science educator(s) will propose making and keeping the public (including science students) pig-ignorant of that risky "overlap" area of scientific thought. If the intersection of Set A (cultural obstacles to science) with Set B (important things we know because of science) makes it harder to care about science (harder to grow the scientists of the next generation) then by all means—someone, somewhere, will say—make science education "safe for future scientists" by culturally and educationally censoring out the area where B overlaps A!

Any bets that this would not happen, once some significant number of scientifically minded folks had good, solid rea-

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son to believe both (a) Flynn's argument and (b) some fact which, according to Flynn's argument, posed a cognitive obstacle to science if known and accepted as fact?

Of course, not one word of the above has the least bearing on whether or not Flynn, a multiple universe hypothesist, or anyone else has gotten it right or gotten it wrong—any more than pi becomes a rational number if some intelligent species evolves with a subtle neurological quirk that makes a member's brain implode as soon as that individual forms or accepts the concept of "irrational number." But what on Earth (or off Earth) will science educators do if the truths inescapably demonstrated by science ever do turn out to include some concepts inimical to thinking scientifically?

Kate Gladstone
Albany, New York

The author responds . . .

Question: Whether a society can abandon the preconceptions that enabled the development of science and still maintain science.

Objection: It would seem that society could not do so, for reasons stated above by Gladstone.

On the contrary: Lightfoot sang, "Though your mother was your maker/From her apron strings you pass."

Therefore, I say: It depends on whether the preconditions are more like the root of a tree or the chrysalis of a butterfly. If the former, the tree dies when the roots are cut off; if the latter, the butterfly lives while leaving the cocoon behind. Analogies are always suspect, even in a magazine named *Analog*, but it would seem that an idea, once firmly planted in society, would remain after the original impetus in the same way that a tree survives the landscaper. Thus, the idea that material bodies have natures and these natures act directly upon one another according to the "common course of nature" seems fully accepted. Few people now suppose that a river can be placated by appealing to its sprite. Even creationists crave recognition for "creation science" and contend, contrary to theology, that God can be demonstrated by the material evidences of biochemistry. This is akin to proving the existence of Frank Whittle by careful measurement of particular jet engine components.

However, the decay of science has been due more to the uncritical acceptance by many scientists of Popperism and its consequent irrationalism. The distinctions among episteme, pistis, and doxa have been blurred; as have those among the Physics, mathematics, and the Metaphysics and among observed fact, natural law, and physical theory. Even scientists often fail to distinguish between what we know and what we think we know. The contention that science is a social construct of privileged white males and that "feminist biology" or "Native American anthropology" represent "other truths" and "other ways of knowing" constitutes a decidedly "political" science that stems from the worship of multiple, and sometimes conflicting gods. The expression "other truths" is reminiscent of the Averroeist "double truth" condemned at Paris in 1277.

Reply to the Objection. There cannot be multiple gods. If two gods existed, they would differ from each other and one would possess a quality that the other lacked. But then the one lacking the quality would not be absolutely perfect and hence not a god. Similarly, multiple universes cannot be a matter of science. If two universes existed, the one would either be observable or not to the other. If observable, it is simply another part of a single *uni*-verse. If it is not observable, it is not an object of science, which deals only in that which can be empirically verified. Therefore, the dangers to science from these two possibilities are not likely. ■

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UPCOMING EVENTS Anthony Lewis

21–23 September 2007
FOOLSCAP IX (Washington state SF conference) at Sheraton Bellevue, Bellevue, WA. Guest of Honor: Charles de Lint; Artist Guest of Honor: Charles Vess. Registration: $45 until 20 September; more at door. Info: www.foolscapcon.org; chair@foolscapcon.org.

21–23 September 2007
MOUNTAIN-CON III (Utah SF/media conference) at University Park Marriott, Salt Lake City, UT. A Celebration of Fandom. Guests of Honor: David Prowse, Garrett Wang, Barbara Luna, Felix Silla, Eric James Stone, Dan Willis, Paul Genesse, Robert J Defendi, Howard Tayler. Registration $40 in advance; $5 at the door. Info: www.MountainCon.org; info@mountaincon.org; Mountain-Con III c/o Carl Stark, 3872 West 2550 South, Ogden, UT, 84401-9007.

28–30 September 2007
CONTEXT 20 (SF reader/writer conference) at Midwest Hotel and Conference Center, Columbus, OH. Author Guest of Honor: Tim Powers; Editor Guest of Honor: Mike Resnick; Horror Guest: Michael Arnzen; Anime Guests: Matt Greenfield, Tiffany Grant; Special Guest: Walter Hunt; Musical Guest: Tom Smith. Registration: $35 until 15 August 2007; $45 thereafter; $50 at the door. Writers Workshops: check website for fees. Info: http://www.contextsf.org

1–4 November 2007
WORLD FANTASY CONVENTION at Saratoga City Center and Saratoga Hotel & Conference Center, Saratoga Springs, NY. Guests of Honor: Carol Emshwiller, Kim Newman, Lisa Tuttle; Special Guests of Honor: Barbara & Christopher Roden, George Scithers; MC: Guy Gavriel Kay. Registration $135 until 31 March 2007, $35 supporting. Info: http://www.lastsfa.org/wfc2007/; World Fantasy 2007, Post Office Box 1086, Schenectady NY 12301. ■

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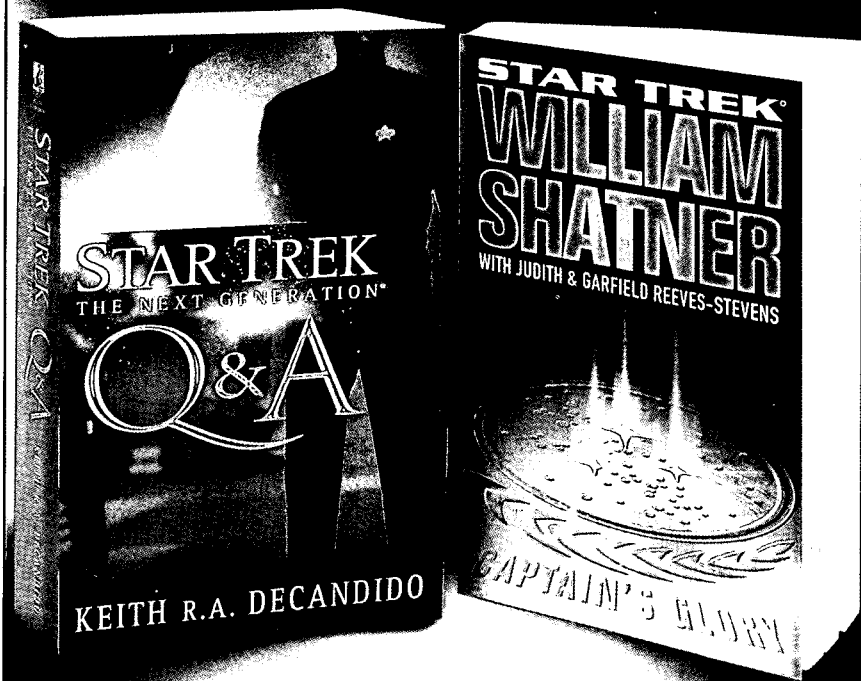

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